Technical Report 1107

Applying Collaborative and e-Learning Tools to Military Distance Learning: A Research Framework

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14. ABSTRACT *(Maximum 200 words)*

This report is a resource guide for those concerned with using collaborative and e-learning environments – those that use the Internet -- in a military training setting. The report is intended for training developers and planners, instructional designers, and program evaluators. The report offers a broad examination of findings from the educational literature, where the preponderance of research on e-learning tools and collaborative learning (i.e., groups of learners who have a common goal) has been conducted. Reviewed first are the emergence of e-learning tools and constructivism, the role of the instructor in such approaches, and the increasing importance of learner-centered approaches to instruction. Appropriate quantitative and qualitative research methodologies are then described. A summary of relevant findings on collaborative tools, individual differences, and learning communities is also provided. Suggestions are made for experiments that test the adaptability to military training environments of e-learning and collaborative learning methods emanating from education. Ten primary and 17 secondary experiments are devised that derive from current psychological principles in cognition, motivation, social factors, and individual differences as applied to Internet-enabled learning.

15. SUBJECT TERMS

training, education, distributed learning, distance learning, online instruction, Web-based instruction, e-learning, collaborative learning, learning communities, learner-centered

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Personnel Performance and Training

FOREWORD

The U.S. Army Research Institute for the Behavioral and Social Sciences is examining the use of distance learning technologies for use by soldiers in an "on demand" environment. This research under the TRAINTODAY project, sponsored by the Training and Doctrine Command (TRADOC), seeks to provide guidance to the Army as it transforms from a classroom-centric method of instruction to one that is more soldier-centric and collaborative rather than classroom based.

In recent years, the field of educational technology has witnessed the emergence of many e-learning tools (tools for instruction that use the Internet) as well as many collaborative learning environments for online instruction. As the TRAINTODAY project shifts focus to Web-based collaborative learning, experimental approaches need to be determined. At the same time, the many results and methods developed in education need to be considered for inclusion in the Army's future plans. Strategies to adapt the best practices from education to military training need to be pursued. The research framework for these plans and strategies was presented to the Training Development and Analysis Directorate, TRADOC on 2 August 2000.

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Applying Collaborative and e-Learning Tools to Military Distance Learning: A Research Framework

EXECUTIVE SUMMARY

Research Requirement:

The Army is embarking on a transformation to deliver standardized individual, self-development, and small group training to soldiers through the application of networked communication systems. Army training will become more learner-centric with soldiers assuming increased responsibility for the acquisition of knowledge and the development of skills. The documentation of approaches to learning and the tools needed for such a learner-centric paradigm has been much more extensive in educational rather than training settings. Because of differences in the goals, outcomes, and eventual performance applications of what was learned, education and training have fundamental differences. One cannot assume that what works well in education will necessarily work well in training. An examination of this educational literature along with a research framework on how to adapt the benefits of collaboration and e-learning to military training in a soldier-centric paradigm is needed.

Procedure:

Database searches yielded over 230 relevant reports, 80 percent published since 1996. Summaries of findings on collaborative tools, individual differences, and learning communities are provided and gaps in the research literature are identified. A set of experiments derived from this literature are designed to evaluate the adaptation of research findings from the educational literature to an Army training context.

Findings:

Educational research literature points to clear research directions for learner-centric approaches within military training. The training approaches derive from psychological principles in cognition, motivation, social factors, and individual differences. The key research areas include instructor's roles in online training, online moderators, learner perceptions, methods for online collaboration, interaction schemes, collaborative tools, online communities, and learning styles. Ten primary experiments are profiled in terms of theory, independent and dependent variables, hypotheses, and follow-up training activities.

Utilization of Findings:

The proposed experiments can be implemented in a number of ways. For example, the experiments can be embedded in courses undergoing a transition from the classroom to a distributed learning environment. The experiments can be applied to either professional development education or specialized skill training throughout the military. The conduct of several primary experiments is planned as part of continuing research on training tools in web-based and collaborative environments by the U.S. Army Research Institute.

Applying Collaborative and e-Learning Tools to Military Distance Learning:
A Research Framework

Contents Page

LIST OF TABLES

Applying Collaborative and e-Learning Tools to Military Distance Learning: A Research Framework

Introduction

For reasons of cost and accessibility, the Army has a growing need for training to be delivered in the future on an "anywhere at anytime" basis through distributed training technologies (TRADOC, 1999). Towards this end, the Training and Doctrine Command is transforming courses and classrooms to accommodate the distributed training concept. The National Guard Bureau established the Distributive Training Technology Project, which provides high network links to armories in all states and territories. The Army Reserve has a Distance Learning Futures Group examining alternatives to the traditional classroom training model. The pedagogical methods and instructional technologies supporting such a transformation must be tailored to this future training environment, which will certainly include new and creative approaches for soldiers to learn.

The Internet is advancing the creation of engaging e-learning tools that transcend typical time and space barriers. E-learning tools refer to Internet-based programs designed for instructional purposes, such as interactive multimedia displays or threaded electronic messaging. Web-based collaborative environments are a special category of e-learning tools that support a group of learners in achieving a common learning goal. Both have been successfully established in educational settings from K-12 to higher education (Bonk & King, 1998). Within the military, collaborative environments have been used for training collective skills over high-speed communication networks linking remote simulators (Shlechter, Bessemer & Kolosh, 1992).

Little systematic research, however, has been conducted in applying the new genre of e-learning tools to military training. This report presents a framework for applying these new educational technologies to military training settings. The framework, as described by a series of experiments, can serve as a basis for developing and evaluating Web-based approaches to small-group instruction and individual training in the Army[1].

Systematic research on collaborative learning and online tools has flourished due to funding from the National Science Foundation, the Department of Education, numerous foundations, national associations, and intramural university support. Naturally, the focus has been on educational results rather than training outcomes. A central issue is whether the benefits of Web-based instruction reported in the educational literature can be adapted to the Army's new training delivery strategy. The Army should consider leveraging successful research and instructional practices found "anyplace anyhow" to meet its future "anytime anywhere" training strategy. As described later, caution should be taken when assuming that what works well in education will necessarily work as well in training. To gain the full benefits of Web-based instruction, a broad examination of the educational literature on e-learning tools is needed.

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[1] There are certainly examples of educational settings in the military, such as those related to professional development education, which account for 6% of the military training load. However, the large investment is in training specialized skills, the remaining 94% of the training load (Department of Defense, 1999).

Alongside this examination should be a framework for transforming what has worked in education to what can work in the Army. This report addresses these needs.

Report Overview

This report is intended as a source guide for those involved with planning, evaluating, and implementing e-learning and collaborative tools in military environments. It is particularly suited for those who require a broad review of recent advances. This report focuses on opportunities for e-learning application rather than on analyses of specific Army training issues, the impetus being the Army's transformation of training to a distributed learning enterprise. Generic examples of how these technologies can be applied to specific training issues in Army settings are offered.

The report discusses the state of Web-based training and online collaboration from a learner-centered psychological perspective. Next, it summarizes the research on online learning and simultaneously identifies key areas to target for research. The review of the extensive literature on e-learning technologies and collaborative tools in the educational arena is intended to be in depth and focused on recent advances – of the over 230 citations, nearly 80 percent were published between 1996 and 2000. This section ends with a description of the key components of electronic learning communities. Once the research is summarized and gaps identified, experiments are suggested for military training settings.

As a note to the organization, six lengthy tables have been moved from the body to Appendix A in the interest of readability. Also, all URL links have been consolidated in Appendix B, with reference to the appropriate page number.

Distributed Learning Background

A marked shift in military training is underway. The Training and Doctrine Command (TRADOC) is embarking on a major change to deliver standardized individual and self-development training to soldiers through the application of multiple media and networked delivery technologies. Training is to move from a classroom-centric delivery of instruction to a learner-centric model, in which soldiers assume greater responsibility for learning facts, procedures, and complex skills as well as teamwork skills. In concert with this paradigmatic shift, the Army Research Institute is pursuing advanced research on Web-based instructional methods and learning strategies that can make training available in either the workplace, at soldiers' residences, or other alternatives to the traditional classroom.

Related to the Army's change in training delivery, the Department of Defense (DoD) has established the Advanced Distributed Learning (ADL) initiative. This initiative grew out of the DoD strategy to "harness the power of learning and information technologies to modernize education and training" (DUSD (R), 1999). This initiative capitalizes on emerging network technologies to tie together distributed instructional resources, including intelligent tutors, subject matter experts, and traditional instruction to support learner-centric education on a continuing basis. The ADL initiative also marks a shift from the current classroom and distance teaching philosophy to a model of anytime, anywhere learning.

ADL Workshop. A front-end assessment framing ADL research issues was conducted at a four-day ADL Science and Technology Workshop held in October 1999. An outcome of that workshop was a vision that *"ADL in 2012"* will be collaborative, affordable, and adaptive instructional environments. Individuals and teams will be supported by a system that promotes competencies such as problem solving, analysis, evaluation, reasoning, and decision making. They will be supported by an instructor and peer-based dynamic mentoring environment. One of the key research areas identified during the workshop concerned collaborative, group, and team learning. The objective of such research is the development of mechanisms to enhance instructional effectiveness of learner-learner collaborations, learner-instructor interactions, and to promote team-building skills. Key technical areas are an understanding of the role of interaction and collaboration in learning and a definition of models for collaboration and interaction considering distance, content, roles, and task requirements. The research framework outlined in the present report is compatible with these ADL research goals.

As we enter the 21st century innovative learning tools for education and training continue to evolve and expand. Virtual communities, distributed simulations, virtual realities, online visualization tools, intelligent agents, and technology for displaying complex patterns of knowledge have all reconceptualized distance learning environments during the past decade (Dede, 1996a). The proliferation of Web courseware technologies and collaborative tools multiply the opportunities and challenges facing higher education as well as training environments (Gray, 1999). Learning will be seen as more socially shared, active, and interactive than in the past. In fact, Dede (1996a, p. 29) argues that "education must help all students become adept at distance interaction because skills involving information-gathering from remote sources and collaborating with dispersed team members are as central to the future workplace as learning to perform structured tasks quickly was to the industrial revolution." Since the preponderance of research has been oriented to educational rather than training settings, so a brief review of the distinction is needed.

Education versus Military Training

Education and training share the psychological constructs of learning, memory and motivation. However, fundamental differences in the goals, outcomes, and eventual application of the underlying instruction distinguish the two. Learning outcomes are measures of the knowledge gained from an instructional program. In education, which has historically been concerned with the social and intellectual development of the whole person, there is no upper limit to how elevated a learning outcome should be. The range of a learning outcome is generally open ended. The thought of producing a student who is "over educated" is inconceivable to an educational provider. In contrast, the thought of a student being over trained can be costly, in terms of time and money, to a training provider. It is better to have the prepared student productive on the job rather than remain in a classroom.

Military training is concerned with increasing the capacity to perform military functions and tasks (Dept. of Army, 1990). For training specialized skills in the military, learning outcomes are established by doctrine and the criteria for acceptable proficiency are generally fixed. For example, soldiers are often rated on the dichotomous Go/No-Go scale on tasks during formal training. The immediate goal of training specialized skills, then, is moving a trainee from ground zero to at least the acceptable criterion. Once the initial level of proficiency is achieved,

learning can continue in a workplace context during follow-on assignments. Learning beyond the criterion during formal training is nice but not always necessary[2].

Although a new instructional practice might succeed in an educational setting, there is no guarantee of its success in a military training environment. Differences in terms of learning cultures, social interactions, motivational, and affective factors can influence the transfer potential between environments (Seidel, 1994). Moreover, the fundamental distinction between education and training, the former focused on the open acquisition of knowledge and the latter focused on improving job performance, must also be considered. The benefits of innovative approaches to instruction can be ultimately determined through research that adapts and evaluates the new collaborative and e-learning tools in Army settings.

As training in military settings becomes increasingly distributed through the Internet or intranets, it is advantageous to understand the documented Web-enabled instructional approaches and learning results. Key military reports advocate research on interaction and collaboration in learning, collaborative activities and interaction strategies, the effectiveness of team-level tutoring, and associated models for this collaboration (DUSD(R), 1999). Such reports also discuss the need to establish more learner-centered, constructivist training environments.

The Army has a vested interest in collaborative learning and is initiating several applications. For example, the Depth and Simultaneous Attack Battle Lab (D&SABL) at the Field Artillery School is witnessing a tremendous influx of automated, information handling, and decision support systems designed to support collaborative operations between military decision-makers and the staff elements (Siegel, Burton, Barnette, Ross, Ross, & Klinger, 2000). In determining the requirements for a collaborative system, the D&SABL is examining information requirements, information flow, and situational awareness in synthetic task environments. Pilot studies are underway examining collaborative environments in these training contexts. In another example at the U.S. Army Armor School, the use of collaborative learning environments is being tested (with National Guard soldiers) in the "synchronous remote" phase of the Armor Captains Career Course. Students at remote sites collaborate through role playing of various staff positions in the venue of a virtual tactical operations center. Collaboration occurs both through a live audio connection and online chats with the use of added collaborative learning tools proposed for future iterations of the course. This course is a candidate for one of the initial experiments proposed later in this report.

The Emergence of E-Learning Technologies

This section shifts focus to the growth of interest in e-learning technologies. The concept of constructivism, which underpins many of the recent advances in e-learning and collaborative environments, is described. An accounting of learner-centered principles in psychology is presented. These principles should be of concern to those involved with the shift from a

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[2] One method for improving skill retention is to maximize the amount of original learning (Wisher, Sabol & Ellis, 1999). Learning beyond the fixed criteria can be useful for skill retention; if it is important to do so, then the criteria should be adjusted.

classroom model to a soldier-centric model of training. A lengthy review of specific findings in the educational field then sets the stage for the experimental framework in training.

There is a myriad of reports in response to the current wave of online teaching and e-learning in education. Some speak to the increase in online course offerings as well as universities involved in e-learning. In fact, there are already more than 50,000 courses taught online and 1,000 universities developing and offering such courses (Carnavale, 2000; National Center for Education Statistics, 1999). Others discuss the costs or obstacles for taking such courses as well as the forms of resistance to such courses and programs at both the institutional and individual level (Jaffee, 1998). Still others are focusing on key market trends, social demographics, stakeholders, policy makers, major players, and workplace needs (Cronin & Duffy, 1997; Upitis, 1999).

One such report from the TeleLearning Network Centers of Excellence (TeleLearning NCE) of Canada compared eight key post-secondary institutions offering e-learning. They also provided a preliminary analysis of universities emerging in this field (Massey & Curry, 1999). Importantly, the TeleLearning report contained a competitive analysis of the courses/programs, pedagogy, and learner support in place at each of these institutions. In addition, it addressed expansion plans, marketing, faculty, learners/clients, and course production and delivery. As such, this particular report provided useful insights into the direction of online technologies and course delivery.

Web-based distance learning is a growing field with rapid changes. Why the flurry? One reason is the shelf life of technical skills is now about five years (Oblinger & Maruyama, 1996). Continual reskilling is a fact of life. In addition, according to Oblinger and Maruyama, students are more diverse than in the past; they are often older students who prefer to attend college on a part-time basis. "Internet courses have clearly emerged as the technology-of-choice for part-time adult students who cannot physically attend classes, either because of situational or dispositional barriers" (Edelson, 1998, p. 3). Peter Drucker's prediction that universities may not survive the next 30 years may be bold and overstated, but the Web has definitely opened up new options for students. Nearly all Fortune 1000 companies already offer some type of computer-based training online, and, soon, almost every major university will offer at least some of its' courses online (Herther, 1997). The emergence of the corporate university to provide an enterprise-wide strategy for online learning is a recent national trend (Kenyon, 1999). With such rapid changes, there is much uncertainty and controversy of opinions about the directions of distance learning.

E-learning is becoming more accepted and expected both in training and formal education environments (Hall, 1997). However, according to Besser and Bonn (1997), some great success stories in the early paradigms of distance learning have come from the field of training, not education. This might be explained by the fact that communicating specific skills and training them to a fixed standard may be easier in a distance learning environment. Despite the rapid adoption by business and industry, it is difficult to find research on e-learning within training environments that attempts to answer some of the critical questions: What are the advantages of such technologies in corporate, governmental, and military settings? How can

effectiveness be measured? What are powerful pedagogical approaches for online learning in the workplace?

There are predictions that Web-based training will grow tremendously in adult and vocational education settings as well as in corporate training sectors (Imel, 1997; Phillips, 1998). Trends in military training often parallel those experienced in their counterparts in corporate and higher education settings. For instance, as with most workplace and college classroom settings, there are increasing demands within the military for learner-centered instruction and the use of technology tools for e-learning, especially those tools that attempt to foster collaboration (U.S. Army Research Institute, 1999; Appendix B).

Partially in response to these trends, the Army also plans to convert 525 courses to distance learning formats for delivering training on demand (TRADOC, 1999). This is a substantial undertaking requiring careful thought and experimentation. Already there are experiments to use the Web for role play, such as war simulations and case-based crises within military training (Campbell, 1997; Comeaux, Huber, Kasprzak, & Nixon, 1998). Virtual battlefields have been created to develop military skills such as decision making during virtual battles and maneuvers (Dede, 1996a).

To address some of the issues noted above, the ADL initiative described earlier is intended to utilize emerging network technologies, foster collaboration, control training costs, and facilitate the development of needed technologies (DUSD(R), 1999). This push coincides with the development of a fourth generation of distance learning technologies rich in collaboration, multimedia, and interaction (National Center for Education Statistics, 1999). Technology tools for chat sessions, virtual whiteboards, application sharing, desktop videoconferencing, computer telephony, multi-user simulation environments, asynchronous communication, and audiographics will push the envelope of online training to a more collaborative and team oriented framework than in the past. Such interaction points also to the growing importance of collaboration, reflection, critical thinking, evaluation, and decision making skills, instead of low-level factual knowledge (Bonk & Kim, 1998; Wisher, et al., 1999). As Web technologies proliferate, skills in searching, discovering, filtering, integrating, and disseminating knowledge are vital.

Constructivism

Prominent reports from educational researchers argue that traditional instructor-centered approaches must be replaced with more active instruction (Duffy & Jonassen, 1991). Instead of viewing knowledge as an arbitrary set of facts, knowledge needs to be constructed by the learner so that it can be used as a tool for future learning activities. The focus of education and training needs to shift from passive reception of data to student knowledge transformation wherein an individual constructs new knowledge through interactions and negotiations. Constructivist principles include building on student prior knowledge, making learning relevant and meaningful, giving students choice and autonomy, and having instructors act as co-learners. Instructors might design tasks wherein learners solve real world problems, reflect on skills used to manage one's own learning, address misconceptions in their thinking, categorize problems around themes and concepts, and generally take ownership for their own learning (Duffy & Cunningham, 1996).

There are at least two important variations of constructivism--cognitive constructivist and social constructivist. Cognitive constructivists tend to focus on the individual construction of knowledge discovered or built in interaction with the surrounding environment. From this point of view, it is important for trainers to foster active learning environments wherein learners individually build and construct new knowledge. Basically, the cognitive constructivistic view regards knowledge as internally represented in the mind of the learner. Unfortunately, individual notions of constructivism often fail to emphasize the vital social aspects of learning and cognition--the collaboration, negotiation, dialogue, and questioning of active learning environments. In contrast, social constructivists view learning as connection with and appropriation from a larger social context. Instructional methods from this latter view focus on dialogue, instructor co-learning, and the joint construction of knowledge.

As indicated above, cognitive constructivists focus on making learning more relevant, building on student prior knowledge, and addressing misconceptions. Social constructivists emphasize human dialogue, interaction, negotiation, and collaboration. Across both viewpoints, constructivistic practices emphasize active, generative learning wherein instructors continue to perform a critical learning function as learning guides. The focus here is on assisting learning, not in directing or assessing it. The impact of using guided or assisted learning, instead of either mechanistic or discovery learning systems, fosters positive effects on learning. In an e-learning environment such assistance might include questioning, task structuring, coaching, modeling, pushing students to articulate ideas and explore new avenues, and occasional and timely direct instruction. From a social constructivist point of view, new learning communities can emerge (Scardamalia & Bereiter 1996). For the Army's transformation from the current model of classroom instruction to the visionary future, the implications are enormous for students, instructors, and training managers.

Learner-Centered Principles

During the early 1990s, the American Psychological Association (APA) announced a set of 14 Learner-Centered Psychological Principles (LCPs) shown in Table 1. These were based on research from the fields of learning and instruction, motivation, and development since the emergence of cognitive psychology in the 1970s and 1980s (Alexander & Murphy, 1994; APA, 1993; Learner-centered psychological principles revised, 1996) (see Table 1). Intended to help with school reform and redesign, the LCPs address areas such as fostering curiosity and intrinsic motivation, linking new information to old in meaningful ways, providing learner choice and personal control, nurturing social interaction and interpersonal relations, promoting thinking and reasoning strategies, constructing meaning from information and experience, and taking into account learner social and cultural background. These 14 principles have significant promise for Web-based instruction (Bonk, Appelman, & Hay, 1996; Bonk & Reynolds, 1997). In fact, Bonk and Cummings (1998) document a dozen recommendations for designing Web-based instruction from a learner-centered perspective. These guidelines describe the need for creating a psychologically safe environment, facilitating learning, electronic mentoring, and other related ideas. In a nutshell, the LCPs provide the backdrop for thinking about online instruction.

Table 1

Learner-Centered Psychological Principles Revised (see Appendix A for detailed table)

	Cognitive and Metacognitive Factors
1.	Nature of the learning process.
2.	Goals of the learning process.
3.	Construction of knowledge.
4.	Strategic thinking.
5.	Thinking about thinking.
6.	Context of learning.
	Motivational and Affective Factors
7.	Motivational and emotional influences on learning.
8.	Intrinsic motivation to learn.
9.	Effects of motivation on effort.
	Developmental and Social Factors
10.	Developmental influences on learning.
11.	Social influences on learning.
	Individual Differences
12.	Individual differences in learning.
13.	Learning and diversity.
14.	Standards and assessment.

For a full text of the principles listed as well as additional rationale and explanation, refer to the APA Website (Appendix B) or write to the APA for the December, 1995 report "*The Learner-Centered Psychological Principles: A Framework for School Redesign and Reform*". Permission to reproduce this list has been granted by APA.

Many educational technologists are advocating the need to shift from instructor-centered to student-centered approaches (Bracewell, Breuleux, Laferriere, Benoit, & Abdous, 1998; Hannafin & Land, 1997; Harasim, 1990). Learner-centered pedagogy asks what students need to learn, what their learning preferences are, and what is meaningful to them. Web-based instruction provides opportunities for learning materials, tasks, and activities to fit individual learning styles and preferences. Networks of learning information, such as digital libraries, are available to peak student interests and ideas. Such environments also provide access to more authentic learning communities than typically found in conventional educational environments.

In accordance with the learner-centered movement, online tools should provide opportunities to construct knowledge, actively share and seek information, generate a diverse array of ideas, appreciate multiple perspectives, take ownership in the learning process, engage in social interaction and dialogue, develop multiple modes of representation, and become more self-aware (Chong, 1998; Harasim, 1990; Oliver & McLoughlin, 1999). Simply stated, technology rich environments can support learner engagement in meaningful contexts, thereby increasing ownership over their own learning (Chung, Rodes, & Knapczyk, 1998). A detailed look at the examples, functions, and supporting research for learner-centered environments can be found in Hannafin and Land (1997).

Doherty (1998) noted that that emergence of hypermedia technology combined with asynchronous learning networks provides greater opportunity for learners to take control. She argues that learner control will be the most dominant characteristic of this new form of instruction. Clearly, the "learn anytime, anywhere," manner of thinking will foster additional expectations for greater learner control and learner options. With increasing expectations that a learner will be guiding his or her own learning, instructors need to develop pedagogical strategies and employ technological tools that foster self-directed student inquiry and investigation. In such an environment, tools and tactics for student manipulation of information, discovery, generation of artifacts, and sharing of knowledge are highlighted (Hannafin & Land, 1997). When this occurs, students can examine problems at multiple levels of complexity, thereby deepening understanding.

As an example, Hannafin, Hill, and Land (1997) focus on the student-centered benefits of open-ended learning environments (OELEs). In OELEs, knowledge evolves as understanding is modified and tested, while learners begin to evaluate their own learning needs. Basically, the focus is on relevant and meaningful problems linked to everyday experiences. In accordance with the vision of student-centered environments, OELEs support self-regulated learning, enable novices to negotiate through complex problems, showcase knowledge interrelationships, anchor concepts in real world events, and nurture various problem solving processes. Clearly, these are complex but powerful learning environments.

Advances in interactive and collaborative technology is forcing instructional designers and technology users to confront and envision learner-centered instruction as well as their role in it. Fortunately, the Web is emerging as a viable teaching and learning platform for learner-centered instruction at the same time that there is a call for incorporating learner-centered approaches in education. It is difficult to tell whether this will lead to serendipitous or tremulous events or both. However, what is clear is that there is a dearth of pedagogical tools for Web instruction (Bonk & Dennen, 1999; McLoughlin & Oliver, 1999). Most Web tools available today do not help transform education as promised. Instead, e-learning courseware simply facilitates course administration and registration procedures.

Web-Based Learning Models

Most Web courseware is embedded with devices for tracking, managing, and controlling student learning, rather than innovative ways to nurture student control and responsibility for learning. This situation is not really surprising since such courseware tools emanate from a behavioral learning model (Firdyiwek, 1999). At the same time, there is an outbreak of ideas related to creative approaches for teaching on the Web (Bonk & Reynolds, 1997). Levin and Waugh (1998) detail approaches such as online collaborative teaming, online questioning and answering, Web resource searching and evaluation, project generation and coordination, and student publication of work. Moreover, McLoughlin and Oliver (1999) argue for the development of tools for parallel problem solving, simulating course material, information exchange, database creation, and case-based projects. Wood (1999) points to new instructional opportunities to locate information (i.e., scavenger hunts), conduct research, analyze data, take part in virtual tours, exchange and publish information, and solve problems. The possibilities exist, therefore, for rich electronic learning, but, for the most part, pedagogically sound and exciting Web courseware tools have yet to be developed to take advantage of such opportunities.

Some might argue that educators simply do not know how to utilize emerging Web technologies. In effect, the pace of change is so rapid that pedagogical models are needed to help create and understand Web tools from a constructivist or learner-centered perspective (Bracewell et al., 1998). As Salomon (1998) has noted, for the first time in history, technologies are outpacing pedagogical and psychological rationale. While tools might afford new forms of inquiry and project-based learning, there is a need for task structuring to guide knowledge exploration and communication among learning participants (Bracewell et al., 1998). Bourne (1998), for instance, provides a model of potential shifts in faculty instructional roles with more time projected for mentoring and less for testing.

Other models look at the degree to which the Web is embedded or integrated into a course (Bonk, Cummings, Hara, Fischler, & Lee, 2000; Mason, 1998) as well as the forms and directions of interaction utilized by Web courses (Cummings, Bonk, & Jacobs, 2000). Bonk (1998) responded to the lack of sound tools by creating interactive tools for online portfolio feedback, profile commenting, and Web link rating, while Oliver and McLoughlin (1999) are building tools for online debates, reflection, concept mapping, and student surveying and discussion. Given these recent trends, the coming decade should witness a growth spurt in pedagogically-based e-learning technologies.

Trends in pedagogy are converging with the emergence of e-learning technologies that allow for greater learner control, personal responsibility, and collaboration. Self-directed learners who want meaningful and engaging activities as well as instructors willing to experiment with a variety of techniques and practices to individualize learning tend to be more attracted to e-learning settings (National Center for Education Statistics, 1999; Wagner & McCombs, 1995). Fortunately, e-learning is a unique context wherein learner-centered principles are particularly relevant as students become the center of the learning environment. In fact, in successful online courses, students might assume significant instructional roles such as offering instructional tips and constructing new knowledge that were once the domain of the instructor (Harasim, 1993). Along these same lines, Levin and Ben-Jacob (1998) predict that a key component of learning in higher education at the start of this millennium will be collaborative learning. Such student-centered learning environments will undoubtedly be flavored with team learning opportunities.

Learning Team Centered Approach

In training environments, both IBM and the Lotus Institute have published white papers that address the need to extend learner-centered approaches to "learning team centered" approaches (Kulp, 1999; Lotus Institute, 1996). According to these reports, not only do e-learning environments offer opportunities for actively interpreting, questioning, challenging, testing, and discussing ideas, but they provide a means to collaboratively create and share new knowledge.

The role of the instructor in such an environment is to facilitate student information generation and sharing, not to control the delivery and pace of it. A key goal of team-based learning activities is to apply expertise and experience of the participants to a group problem solving situation or research project that helps participants accomplish something that they could

not achieve individually. Other objectives include the fostering of teamwork, communication, and listening skills (Lotus Institute, 1996). While Kulp (1999) admits that small team collaboration in e-learning requires significantly more time and effort, it can generate new knowledge, attitudes, and behavior. He recommends the use of roles such as coordinator/leader, starter or resource investigator, summarizer, scribe, encourager, specialist, implementer, and checker. The following section will shed some light on how an instructor effectively assumes such roles.

New Role for Instructors Online

If the Army is to gain the full benefits of online instruction, a significant change in the preparation of instructors will be required. The lessons from education are that online learning is an entirely new type of educational experience requiring a redesign of instructor roles, responsibilities, and commitments (Besser & Bonn, 1997) as well as support and training for those teaching online (Lawrence, 1996-97). The potential instructional roles might seem daunting. As student-centered activities are increasingly facilitated by emerging technology, the role of the faculty member or instructor shifts to facilitator, coach, or mentor who provides leadership and wisdom in guiding student learning (Dillon & Walsh, 1992; Doherty, 1998). Of course, until instructors feel comfortable and gain experience in this new role, online courses may experience higher than expected drop out rates (Carr, 2000a; Appendix B).

Instructors have a number of roles that they can assume online such as chair, host, lecturer, tutor, facilitator, mediator, mentor, provocateur, observer, participant, co-learner, assistant, and community organizer. From one perspective, a good moderator is like a successful host or hostess: he or she must know how to connect guests together at the party with similar interests and bring those hiding on the fringes into the community (Rogan & Denton, 1996). From another perspective, it might be important for the instructor to act as a co-learner or participant in online activities. Rice-Lively (1994) found that the online instructor must be flexible in constantly shifting between instructor, facilitator, and consultant roles. At the same time, instructors must create an ethos of mutual support and community so that students with limited technology experience can perform well in these environments (Ross, 1996). This is not particularly easy. Fortunately, many of the possible instructor roles can be assigned to students, outside experts, or teaching assistants (Paulsen, 1995a; Selinger, 1999).

Guidelines for Facilitation

Researchers have suggested various guidelines for online facilitation. Cummings (2000) offers a sequence of steps for use within a virtual debate (see Table 2). These steps provide a template for fostering social interaction online. Mason (1991) advocates the organizational, social, and intellectual roles of the online instructor. The organizational role entails setting the agenda, objectives, timetable, and procedural rules for posting and interaction.

Recommendations for instructors include patience, varying the participation, avoiding lecturing, inviting guest speakers, spurring discussion, and addressing unanticipated activities or problems. The social role involves sending welcoming messages, thank you notices, feedback on student inputs, and a generally friendly, positive, and responsive tone. Instructional caveats concerning the social role include reinforcing good discussion behaviors and inviting students to

be candid about the way the course is proceeding. Of the three roles Mason (1991) describes, the intellectual role is the most crucial since it includes probing responses, asking questions, refocusing discussion, setting goals, explaining tasks and overlooked information, weaving disparate comments, synthesizing key points raised and identifying unifying themes, directing discussion, and generally setting and raising the intellectual climate of the course or seminar. Knowing when to summarize, when to expose conflicting opinions, and when to request comments on specific issues is also critical for this role.

Table 2
Sequence of steps within a virtual debate (Cummings, 2000)

Virtual Debate Steps
1. Instructor selects controversial topic with input from class.
2. Instructor divides class into subtopic pairs.
3. Instructor assigns subtopic pairs.
4. Critics and defenders post initial positions.
5. Students review all initial position statements.
6. Students reply to at least two position statements with comments or questions.
7. Each student rebuts opposing initial statement or individual in his/her pair.
8. Based on a review of all statements, comments, and questions, students formulate personal positions.
9. Students post personal position statements in private forums.

A report from a year-long faculty seminar on online teaching and learning at the University of Illinois recommended that, in attempting to facilitate online collaborative learning, instructors be patient, flexible, responsive, and clear about expectations and norms for participation. In addition, such process facilitation requires that they limit lecturing, while monitoring and prompting student participation, organizing student interactions, and writing integrative or weaving comments on occasion. Furthermore, they need to find ways for individuals and small groups to assume teaching-related roles from time-to-time (The Report of the University of Illinois Teaching at an Internet Distance Seminar, 1999). Instructors also need to become adept at promoting interaction, addressing multiple learning styles, performing needs assessments, and projecting a friendly image (Thach, 1993).

Instructor actions. E-learning instructor presence is sensed by students through messages posted to the online conference. Ashton, Roberts, and Teles (1999) suggest that categorizing the online acts of instructors into four categories—pedagogical, managerial, technical, and social—might be helpful in understanding the role of the instructor in collaborative online environments. Pedagogical action includes feedback, providing instructions, giving information, offering advice and preferences, summarizing or weaving student comments, and referring to outside resources and experts in the field. In effect, the pedagogical role relates to direct instructor involvement in class activities. Similarly, online managerial actions involve overseeing task and course structuring. Managerial actions include coordinating assignments, discussions, and the course. Technical actions relate to helping with user or system technology issues. Finally, social actions might include instructor empathy, interpersonal outreach (e.g., welcoming statements, invitations, and apologies), discussion of one's own online experiences, and humor. Ashton et al. (1999) suggest that future research look at the role of the instructor from the start to end of an

online course, across instructors, across offerings of the same course, and across different courses. Additionally, one might wish to explore how different technologies and pedagogical strategies change the instructional interaction patterns and help promote community building. Such issues are addressed in later sections of this manuscript.

Both Bonk and Cummings (1998) and Bailey and Luetkehans (1998) provide several tips for online instructors to create learner-centered environments. These include the need to develop psychologically safe learning environments where there is extensive student interaction and elaboration. Reduction in cyber-stress must be one of the key initial goals. To accomplish this, one's expectations must be clear and prompt. In addition, online learning teams must be assembled according to the tasks involved and available talent and interests. Students in small groups must have open-ended problems with some degree of choice, though timely instructional support is needed when struggling to reach consensus and prompt feedback on decisions. Moreover, student assignments should build on their experience and prior knowledge, while allowing students to find ways to utilize the Web resources and share them with team members. The instructor, for instance, might intervene to indicate where the group members have found some common ground.

Instructors should also take advantage of both public and private forms of feedback as well as online questioning techniques and facilitation that can stimulate student reflection. Along these same lines, instructors should attempt to utilize the Web for social interaction and mentoring to peers and experts outside the class. Students can be electronically apprenticed with timely insights and suggestions from other instructors and students located elsewhere. Finally, in student-centered e-learning environments, instructors should create an atmosphere wherein participants avoid quick judgment and overall negative criticism or personal attacks on one's projects.

Online Moderator Research

While guidelines such as those presented above may be useful, what do online instructors really do? Research indicates that online instructors tend to rely on simple tools such as e-mail, static or dynamic syllabi, Web links to course material, posting lecture notes online, and accepting student work online, while significantly fewer use online chatrooms, multimedia lectures, online examinations, animation, and video streaming (Peffers & Bloom, 1999; see Appendix B).

A study by McIsaac, Blocher, Mahes, and Vrasidas (1999) indicates that instructor time is divided into numerous tasks. In their study, e-learning instructors allocated their time to planning and preparation (10%), online teaching (17%), administration (15%), interaction with peers (21%), interaction with students (15%), and interaction with content (22%). Based on these findings, McIsaac et al. contend that online instructors tend to be more concerned about encouraging student participation and the quality of interaction than might be expected in traditional settings. As a result of this change in role, Web courses take significant amounts of time for instructors to create and coordinate (Gaud, 1999). To help instructors assume such new roles, they need assistance and advice both in the development and delivery of Web courses (Lawrence, 1996-97).

While e-learning moderating talents are not easily explained and understood and online success stories are not pervasive, some guidelines are emerging. According to Selinger (1997), successful moderation seems to include student system familiarity, encouraging introductory messages, clear guidelines and purpose, online guests, and intermittent summaries and refocusing of discussion. Moderators should identify their preferred pedagogical styles and preferred forms of online facilitation and moderation (Paulsen, 1995a; Appendix B). As these roles evolve, researchers need to ask just how much student autonomy and interaction will they promote. Researchers might also inquire about how often will they intervene to offer advice and feedback in student discussions and activities. Some initial research has begun to answer these questions.

Significant teaching and learning changes are underway due to the emergence and popularity of e-learning. For instance, e-learning supports a more social constructivist learning environment wherein students negotiate meaning and are involved in extensive dialogue and interaction. The role of the instructor, therefore, is in transition from director to facilitator or moderator of learning (Selinger, 1999). In addition, electronic learners are more autonomous and independent in their own learning than their counterparts in traditional classrooms. E-learners also have greater opportunities for interacting with other learners, their instructor, and outside experts. Teaching and learning takes on a more collaborative feel in an e-learning environment. Whether this is equally true in education and training environments is uncertain. What is known is that learners in both environments will have greater opportunities for reflection and exploration, thereby expanding ideas about when and where learning in a course actually takes place.

What's next? Given the above time barriers instructors face, perhaps intelligent agents will be developed to provide questions or advice on the particular task students are working on (Kearsley, 1993). Along these same lines, intelligent tutoring systems or modules might be inserted into existing online courseware or specific tools to provide advice or support for student learning (Ritter & Koedinger, 1996). Intelligent tutoring systems have been successfully applied in military settings (Psotka, 1988). Such systems interpret or identify what the student needs to know and suggest activities, information, or advice. Given the increase in distance education and the unfamiliarity of instructors in this environment, it is certainly a ripe area for intellectual support tools and features. As such development occurs, we may begin to better understand how to successfully moderate or facilitate e-learning environments. We also might understand the overall importance of research on Web-based instruction.

Online Collaboration

Owston (1997) asks three basic questions in terms of Web-based instruction: (1) Does it increase learning access?; (2) Can it improve learning?; (3) Can increased access and improved learning be attained without additional costs? Unfortunately, answers to Owston's questions are not readily available. In fact, most research on whether the Web improves student academic performance is strictly anecdotal or attitudinal (Usip & Bee, 1998) or finds no significant differences. Too few educators are asking critical questions about e-learning and, instead, rely on such anecdotal evidence or nothing at all (Windschitl, 1998).

Questions need to be raised in both education and training environments about the processes that occur during online searching, the types of guidance needed, how online learners reach common ground, and the role of the instructor in online collaboration. Is there evidence that students and instructors benefit from e-learning? Do these tools improve teaching and learning? Do different types of learners (e.g., visual, verbal) or learning strategies foster greater achievement (Kerka, 1998; Shih, Ingebritsen, Pleasants, Flickinger, & Brown, 1998)? How do e-learning training environments such as in the military and corporate sector differ from or confirm results found in higher education?

In addition to the limitations of anecdotal data, some argue that most e-learning research is flawed by the lack of control groups, nonrandom assignment to groups, questionable validity, and limited scope (The Report of the University of Illinois Teaching at an Internet Distance Seminar, 1999; Wisher & Champagne, 2000). Of course, there is much to be learned from small sample ethnographic or case study research. In both quantitative and qualitative research, however, the research on e-learning tends to focus on the impact of individual, not multiple technologies. Prior research, moreover, generally fails to consider student learning styles and other individual differences (e.g., self-efficacy, motivation, and gender) in using those technologies. Worse still, this research too often lacks reliable and valid testing instruments while neglecting to theoretically ground the study. Finally, it fails to account for the higher drop out rates experienced in Web-based instruction (National Center for Education Statistics, 1999; Phipps & Merisotos, 1999; Wisher et al., 1999).

Research Methodologies in Collaborative Environments

This section describes the methods used by researchers to quantify, analyze, and report information and data gathered during episodes of collaborative learning. Collaborative environments support learners in achieving common learning goals. The practice of using small group instruction in so many Army training programs creates a natural candidate for collaborative environments, enabling soldiers to draw from the field experiences and multiple perspectives of other soldiers "seated" online rather than around the table. Covered below are the use of quantitative and qualitative measurement instruments, techniques to analyze content, assessment of messages, and methods used for examining conferencing tools, interaction schemes, critical thinking, and learning styles.

Some scholars argue that standard experimental designs are not, practical, relevant, or ethical in online environments (Hiltz, 1990). It is difficult to randomly assign students to traditional course sections when they desire or need the online version. And it may be unethical to change the meeting times for students relying on a course to complete a major. Furthermore, students selecting online courses may differ significantly in their maturity, expectations, and motivation than students in the traditional class. Scholars like Stephen Ehrmann (2000) from the Flashlight Project argue that notions of "normal" or conventional classroom are misguided. Every classroom and program has unique materials, methods, motives, and students. From this perspective, an accounting of comparable costs is problematic, especially given the lack of rationale for enumerating costs per student or class in traditional education.

The literature on online learning details both quantitative and qualitative research instruments (Hiltz, 1990; Howell-Richardson & Mellar, 1996; Riel & Harasim, 1994). On the quantitative side, researchers often discuss usage patterns, computer log data (e.g., number of participants, message number and length, reading time, message creation time, etc.), data mining, video screen grabs, participation rates, participation timing, free or cued recognition tasks, student and instructor attitudes, writing skill improvement, peer responsiveness and interactivity, and various questionnaire data (e.g., Mowrer, 1996). Data mining tools now enable researchers to quickly obtain basic or summary statistics (number of logins, peak hours of usage, location of user, length of session, paths taken, messages by day or week, etc.), classification and association analyses (e.g., grouping user by navigation types or characteristics), time-series analyses (i.e., grouping data for time related trends and similarities), and data visualization (i.e., graphically plotting data about usage, participation, etc.) (Harasim, 1999). Such tools can elucidate the timing and quantity of student online work.

In addition to computer log data, quantitative measures can also assess student skills or traits. For instance, with the heavy emphasis on writing and communicating in most online learning environments, it is not surprising that there is interest in writing skill development and changes in audience awareness or perspective taking (Bonk & Sugar, 1998; Cohen & Riel, 1989). Other measures such as student self-efficacy, course satisfaction, perceived level of learning, and computer anxiety in these environments might also be assessed.

Content Analysis

The tools for assessment on the qualitative side are also rich and varied. Here, researchers often point to interaction and content analyses, discourse quality, verbal protocols, message flow analysis, message thread analysis, task phase analysis, semantic trace analysis, the classification of participant types, forms of feedback, reflective interviews, observation logs, focus groups, retrospective analyses, and user think alouds (e.g., Levin, Kim, & Riel, 1990; Rice-Lively, 1994). In fact, so many methods are mentioned in the literature, it is difficult to know when and where to use them. Message thread analysis entails grouping messages related to one another into common message threads for analysis (Riel & Harasim, 1994). In contrast, task phase analysis is often used to examine interaction patterns and activity during different components of a large-scale project or extended task or unit. Another qualitative technique, semantic trace analysis, is designed to map out the development of a single idea or set of ideas over time. Using this latter method, one might discover that pivotal student contributions actually originated in other classrooms or in discussions of e-learning affiliates (Riel & Harasim, 1994). Focus groups and the nominal group technique might foster discussion related to sensitive topics and open issues that might never be considered otherwise (Eastmond, 1994). Of course, each of these methods has associated pros and cons.

Messsages. Levin et al. (1990) point out that how often a message is referenced by other messages is an indicator of the importance of certain network participants and the direction of the online conversation. Graphic displays of message interaction might signify not only what topics were popular but also member status and dominance. While this is the first step in Semantic Trace Analysis, the next step might be to perform Message Act Analysis wherein each message within a discussion thread is classified according to whether it is in initiation of a discussion, reply, or evaluation. Noting who is performing such acts—teacher or student—is

useful in determining whether the online discussion is following traditional teacher domination patterns (i.e., the quintessential IRE sequences) or allowing for more student-centered learning. Interestingly, Levin et al. found substantial differences between instructional patterns in face-to-face (FTF) classes and online networks, favoring online classes.

These same researchers recommend Message Flow Analysis for analyzing the density of messages in units of time (e.g., weeks of a semester, days of the week, hours of the day, (Harasim, 1999)). Their experience in graphing such messages is that there are peaks and valleys in electronic networks. The troughs might occur at the start of a semester when training is taking place as well as during exams and holidays. Message Flow Analysis can indicate when messages peak early and then fall off (see Kirkley, Savery, & Grabner-Hagen, 1998), as well as when events start out more slowly.

There certainly is no lack of e-learning data in educational settings. Given the wealth of quantitative and qualitative methods, it is not too surprising that there are many evaluation frameworks. In weeding through online data sets, Riel and Harasim (1994) contend that research can be categorized into three areas:

1. the technical and social structure of the network environment
2. the social interaction among the participants in the course, project, or network activity; and
3. the effects of the online experience on the individuals.

Within these three research areas, data analysis can be of a fine grain in analyzing all events or it can be fairly coarse or global (Rouet & Passerault, 1999). At the same time, the environment for this research can range from laboratory studies of individual cognition to design experiments of classrooms and small group collaboration to larger scale testbeds or even reform consortia (Gomez, Fishman, & Pea, 1998). When appropriately combined and understood, these methods allow researchers to analyze social and cognitive activity as it unfolds. For instance, computer logging devices and dialogue transcript records provide researchers with useful tools for tracking student development both over extended periods of time as well as within a single online session.

As Fetterman (1998) accurately points out, technology tools are playing an increasing role in e-learning research. There are now Web tools for data collection, analysis, and reporting. Technologies exist for recording online interviews, sharing preliminary and final data and resources, organizing field notes, searching database engines, locating needed resources, and working with other team members at a distance. Indeed, one might describe this as a revolution in course assessment tools. Electronic surveys are also growing in popularity and usage (Champagne, 1998). While equipment, unfamiliarity, and misperceptions about time required and complexity of the task limit the response rates of electronic surveys (Bertot & McClure, 1996), familiarity with such tools will increase response rates.

As the e-learning assessment tools evolve, researchers might look at both quantitative and qualitative data with student questionnaires and related evaluations, performance measures, observations of interaction patterns, technology evaluations, completion and attrition rates, and cost-benefit analyses (Owston, 1999; Phelps, Wells, Ashworth, & Hahn, 1991; Wetzel, 1996).

Collaborative Tool Interaction Research

Collaborative learning has the potential to foster the interaction and social support traditionally lacking in distance learning environments. In response, there has been a wave of research and design taking place in the field of Computer Supported Collaborative Learning (CSCL) and Computer Supported Collaborative Work (CSCW). The first CSCW conference was held in 1986 in Austin, Texas with 300 people from a variety of backgrounds such as artificial intelligence, human-computer interaction, office information systems, computer science, anthropology, and psychology (Bannon & Hughes, 1993; Appendix B). As a field, CSCW employs groupware tools and group decision support systems to increase the effectiveness of work teams by facilitating, augmenting, and redefining their communication and interaction activities (Koschmann, 1994; Wang & Bonk, 2000). Groupware are computer-based technologies that support groups of people to complete a common task or perform a common goal despite time and space separation and variations in team size (Davenport & McKim, 1995). Tools here include e-mail, computer conferencing, workflow management, collaborative writing and co-authoring software, document management, and calendaring. Groupware products such as Lotus Notes, Timbuktu, and GroupSystems are used in business to generate productivity gains (Kittner & Van Slyke, 1997; McLellan & Knupfer, 1993).

CSCL is the younger sibling of CSCW and is more focused on how collaborative environments enhance student learning and teamwork in academic tasks. The field extends work on using technology as a tool that augments and enhances learning, to thinking about how it also can be used for student collaboration, learning related interaction, and knowledge building (Koschmann, 1996). CSCL tools might support the communication and linking of ideas, the structuring of group dialogue, the tracking of decisions, the visualization and representation of ideas, the generation and evaluation of ideas, the collection and analysis of data, and any online mentoring and feedback (Dede, 1996b). Increasingly, the focus is on supporting the creation of knowledge building communities with extensive online discussion, knowledge sharing and evaluation, and the storage of ideas in communal databases (Hewitt & Scardamalia, 1998). Whereas the first CSCL workshop took place in 1991 (Koschmann, 1994), the first international CSCL conference was not held until 1995 in Bloomington, Indiana. This conference produced both a popular book (Schnase & Cunnius, 1995) and a Web site (Appendix B). Instructional designers, instructional technologists, educational media specialists, educational psychologists, learning theorists, computer scientists, human-computer interaction, and sociologists populate CSCL.

Scholars in these fields want to help people learn or work in teams using technology. In fact, both fields, CSCW and CSCL, are interested in how to electronically share goals and creations, the formation of mutual understandings, and the tools, tasks, and group sizes that foster online social interaction and collaboration. In both environments, the sharing and distributing of information is valued and nurtured. As Michael Schrage's journeys across the country a decade ago indicated, these tools create a socially shared space for users to collaborate and exchange ideas. Schrage (1990, p. 40) defines collaboration as:

> ...the process of *shared creation*: two or more individuals with complementary skills interacting to create a shared understanding that none had previously possessed or could have

come to on their own. Collaboration creates a shared meaning about a process, a product, or an event.

As indicated by this definition, collaboration impacts the way in which people share thoughts and ideas. While both CSCL and CSW shed light on the gaps in learner-centered collaborative tool research, the CSCL area has more consistently addressed this area.

Group Interactions. Groups using electronic brainstorming tools often generate more unique ideas and of a higher quality than verbal groups without such support (Valacich, Paranka, George, & Nunamaker, 1993). Electronic tools have a greater capacity to support concurrent discussions than the more serial medium of verbal communication. In addition, less dominant individuals tend to participate more in computer-mediated tasks than FTF tasks (Citera, 1998).

These findings about student dominance tend to hold in other studies. For instance, using Interaction Process Analysis (IPA), a method created in the 1950s for studying group interaction, Hiltz, Johnson, and Turoff (1986), also found less dominance in the computer condition than in the FTF condition. However, the lack of dominance appeared to impair the ability to reach consensus (see Table 3 for 12 IPA categories). Similarly, Warschauer (1997), in his review of the literature on computer-mediated collaborative theory, mentioned that group member status (e.g., graduate or undergraduate student) is less important in electronic settings. In effect, in electronic discussion, there is less time pressure and fewer social clues, nonverbal cues, and chances for intimidation than in FTF situations. He also found that FTF groups often reach consensus by the third speaker; a point wherein electronic discussions are typically far from complete. In contrast, Hiltz et al. (1986) found that participants in the FTF condition produced significantly more ideas, thereby expediting consensus. There are many such conflicting and inconclusive findings in the e-learning literature.

Table 3
Interaction Process Analysis Categories (Bales, 1950 as cited in Hiltz et al., 1986)

IPA Category	
1. Show solidarity	7. Asks for orientation
2. Shows tension release, jokes	8. Asks opinion
3. Agrees	9. Asks for suggestion
4. Gives suggestions	10. Disagrees
5. Gives opinions	11. Shows tension
6. Gives orientation	12. Shows antagonism

Warschauer (1997) also noted that CMC studies tend to find greater amounts of student participation than traditional classrooms both as a percent of total talk time and in terms of direction toward fellow students. In effect, students have a voice instead of simply responding to instructor prodding. According to his review, studies that focus on computer-mediated collaborative writing find that students write more and of a higher quality, are more collaborative, and become more versatile writers. In effect, there is a general movement from teacher-centered to student-centered learning environments in computer-mediated collaborative learning (see also Hara, Bonk, & Angeli, 2000).

Still the instructor is key to effective learning. In Lau and Hayward's (1997; Appendix B) study of student online surveys, application usage logs, keystrokes, focus groups, and help desk usage, for instance, group members needed clear roles, realistic expectations, and significant resource and facilitator support. Such research findings also replicate studies mentioned earlier—online instruction or facilitation is complex and time-consuming. Furthermore, action research from Kittner and Van Slyke (1997) on group decision support systems in higher education indicates that instructors should plan ahead, have contingency plans, keep experience logs, and test the system ahead of time.

Additional research is needed in CSCL and CSCW environments, especially those where individuals are apprenticed into an authentic learning environment. Computer conferencing in these environments is a significant event since it allows academics, students, and practitioners to work in more close proximity (Pearson & Selinger, 1999), while expanding the forms and opportunities for interaction (Cummings et al., 2000). Research on electronic collaboration during field placements of preservice teachers, for example, reveal that CMC tends to provide social supports that acknowledge and support similar experiences. However, these environments fail to support extensive reflection on course content (Admiraal, Lockhorst, Wubbels, Korthagen, & Veen, 1997). Even CMC environments designed with pedagogical structure and instructions for connecting course knowledge to field experiences often results in student story telling, sharing of ideas, opinionated feedback, and social acknowledgements, not deep course connections and elaborate explanations of terms and principles (Bonk, Hansen, Grabner-Hagen, Lazar, & Mirabelli, 1998). Using learner-centered principles, the Bonk, Hansen et al. study specifically focused on how online scaffolding can come from different participants—peers, instructors, graduate students, conference moderators, etc. They found that students tended to use online networks for the social interaction not for intense cognitive and metacognitive exchanges. Once students move from simply observing to becoming practicing teachers, seeking help will perhaps become more important than moral support, keeping in touch with others, or sharing ideas (Selinger, 1997). (Table 4 is a modification of the scheme used by Selinger to analyze student online contributions.)

Table 4
Uses of Online Conferencing (adapted and modified from Selinger, 1997)

Category of Online Contributions
• Seeking Information/Ideas/Help
• Offering Help or Support
• Clarifying Issues/Concepts
• Moral Support (feedback on ideas, sharing enthusiasm)
• Moral Support (communicating or keeping in touch with students/peers)
• Sharing Ideas, News, and Techniques (e.g., recent events, recent debates)
• Sharing Resources Found or Created
• Contacting Students
• Contacting Instructor/Moderator

Conferencing tools. The design of the technology tools can have an impact on the collaboration in education and training settings. Pychyl, Clarke, and Abarbanel (1999) found that groups function better when collaborative tools on the Web clearly demarcate individual

member contributions, structure participation, provide easy access to group member contributions, allow for individual workspaces, and provide consistent technology for all participants. Along these same lines, Duffy, Dueber, and Hawley (1998) built the Asynchronous Collaboration Tool (ACT) to support user critical thinking and collaboration through conversational and issue-based discussions. Using ACT, students must label their messages according to elements of effective argumentation and requirements for good collaboration. For instance, students might categorize their posts according to the type of message, content source, or perceived importance. The goal of labeling posts is to foster problem solving, reflection, and critical awareness of one's ideas. With ACT, students begin to visualize and reflect on thinking patterns, but it remains an untested tool.

Some tools more explicitly foster visualization of online discussion and interchange. In ArtView, for example, groups of learners discuss common museum images electronically displayed by the instructor (Gay, Boehner, & Panella, 1997). With this tool, students can enlarge images, ask for additional background information, engage in real-time chats, form groups, take tours of artwork collections, and save transcripts. Students here expressed a preference for instructors or guides to have more visual authority. In a study by Ahern and Repman (1994), undergraduate students using a conferencing tool with a graphical interface (i.e., with visual maps of subtopics and participants), produced more messages and spent more time in the system than students in the text-based version of the tool. When multimedia is added to such an equation, there are opportunities to archive ideal forms of performance, replay videoclip performances, store scanned images, interact in a whiteboard, hear expert commentary, and listen to other key players in that environment (Barab & Duffy, 2000). Tools for concept mapping or hypertextual linking will play a vital role in asynchronous training and education in the upcoming decades (Harasim & Stockley, 1998).

There are many tools that might be created to foster online collaboration. When collaborative groups use such tools in the future, they will process information at a higher level, such as engaging in judgment, seeing multiple perspectives, deciding paths of action, and imposing meaning through integrative statements, explanations, and drawing conclusions (Herrington & Oliver, 1999). When sophisticated interaction tools are combined with authentic activities, student reflection and articulation, well defined roles, and timely instructor guidance, powerful learning can ensue (Oliver, Omari, & Herrington, 1998). Of course, since the social interaction, negotiation of knowledge, and resulting learning varies, some researchers have advocated for new and innovative frameworks to better understand online learning and interaction.

Interaction Schemes. Many scholars posit that social interaction and discourse leads to student cognitive development and higher mental functioning (Vygotsky, 1978; Wertsch, 1991). In effect, learning is a social phenomenon wherein students acquire competence when interacting with peers and adults in a learning community. From a sociocultural perspective, the social activities of articulating, exploring, testing and refining and debating ideas can significantly impact student thinking. Online conversations between students, instructors, and expert professionals or practitioners provide a forum for discussing issues and learning to analyze key problems in a discipline (Gay, Boehner, & Panella, 1997). Tools and frameworks to measure such acts are detailed in this section.

The literature on distance learning often breaks interaction into three types: (1) learner-content interaction, (2) learner-instructor interaction, and (3) learner-learner interaction. Wagner (1997) developed a fairly simple scheme to code 13 categories of interactions found in distance learning (see Table 5).

Table 5
Interactions Found in Distance Learning

Categories of Interactions (Wagner, 1997)	
• To increase learning • To increase participation • To develop communication • To receive feedback • To enhance elaboration and retention • To support learner/self-regulation • To increase motivation	• For negotiation of understanding • For teambuilding • For discovery • For exploration • For clarification of understanding • For closure

Social interactions. Given the wealth of data and types of learner interactions, there is a need to look for important patterns in the data (Henri, 1992; Kuehn, 1994). Researchers interested in social interaction have explored online participation patterns and roles, collaborative knowledge construction, levels of argumentation, group development, critical thinking, response complexity, social cues, and cognitive and metacognitive understanding. Henri (1992), for instance, offers a popular framework and analytical model for better understanding the learning process in computer conferencing environments. She highlights five dimensions of the learning process; namely, participation (e.g., rate, timing, and duration of messages), interactivity (e.g., explicit interaction, implicit interaction, and independent comments), social events (i.e., statements unrelated to the content), cognitive events (e.g., clarifications, inferences, judgments, and strategies), and metacognitive events (e.g., both metacognitive knowledge—person, and task, and strategy and well as metacognitive skill—evaluation, planning, regulation, and self-awareness). Henri also offers a second cognitive model intended to examine the depth of processing, surface or in-depth, of information (see Table 6). While this framework is comprehensive and informative, some aspects of this approach (e.g., measuring metacognitive knowledge in online discussions) are highly subjective (Hara et al., 2000).

Table 6
Model for Analyzing Online Processing of Information (adapted and modified from Henri, 1992; see also Hara et al., 2000)

Surface Processing	In-Depth Processing
Repeating information contained in the statement of the problem, text, or previous discussion without making any inferences or offering interpretations	Linking facts, ideas, and notions in order to interpret, infer, propose, and judge
Repeating what has been said without adding any new elements	Offering new elements of information
Stating that one shares the ideas or opinions stated, without taking these further or adding	Generating new data from information collected by the use of hypotheses and

any personal comments	inferences
Proposing solutions without offering explanations	Setting out the advantages and disadvantages of a situation or solution, pros and cons, etc.
Proposing solutions without a sense of implementation criteria and potential problems	Proposing one or more solutions with short-, medium-, and long-term justification
Making judgments without offering justification	Making judgments supported by justification
Asking questions which invite information not relevant to the problem or not adding to the understanding of it	Asking questions designed to provoke content-related responses or investigations and further discussion
Offering several solutions without suggesting which is the most appropriate	Providing proof, supporting examples, counterexamples, relevant analogies or metaphors
Providing the situation in a fragmentary or short-term manner	Perceiving the problem within a larger, connected, or more long-term perspective
Failing to suggest how an idea fits within a larger scheme or framework	Developing strategies and ideas within a wider framework or integrative model

Critical Thinking. Closely corresponding to the cognitive events of Henri's model, Garrison (1991) outlines a five-stage model of critical thinking for adults resembling a problem solving process. These stages include problem identification, definition, exploration, applicability, and integration. Garrison argues that student responsibility and control of one's own learning are central to self-directed learning and critical thinking. He also attempts to link self-direction and collaboration as integral to the critical thinking process. In a way, Garrison (1992) is hopeful that understanding the core elements of critical thinking will provide a unique and important framework for studying adult education. Some online researchers have adapted Garrison's critical thinking model to their analysis of electronic transcripts since students are developing and refining positions, exploring problems, negotiating ideas, questioning the positions of others, and offering problem solutions online (Bakardjieva & Harasim, 1997). The long-term utility of this scheme is difficult to predict.

Newman, Johnson, Webb, and Cochrane (1997) combined Henri's (1991) and Garrison's (1991) models to compare critical thinking in CMC and FTF environments. They developed a student perception questionnaire to measure the degree to which computer conferencing environments help arouse student interest in important issues, explore and develop ideas, critically assess course content and possible solutions, and apply course content to their own life situations. By simplifying the surface and in-depth ideas of Henri (mentioned above and illustrated in Table 7; Appendix A) and also using Garrison's model, Newman, Johnson, Cochrane, and Webb (1996) created a coding scheme for online transcripts addressing statement relevance, novelty, student knowledge and experience, clarity, idea linking, justification, critical assessment, practical utility, and width of understanding and discussion. While critical thinking was evident in both CMC and FTF environments, their content analysis revealed that the depth of critical thinking was higher in CMC environments. More specifically, CMC students were more likely to bring in outside information (personal experience, course materials, etc.), link ideas and offer interpretations, and generate important ideas and solutions. While FTF settings were better for generating new ideas and creatively exploring problems, CMC fostered evaluation and interpretation of such ideas.

Problem interpretation. Such findings suggest that whereas FTF might prove useful in earlier stages of problem solving and critical thinking such as generating ideas, CMC tends to function better in the latter stages of problem interpretation and integration as well as idea linkage. Given these tentative conclusions, researchers might test whether online chat tools could take the place of FTF and equally well support idea generation, while asynchronous tools could be used for evaluating and integrating those ideas. In fact, Bonk, Hansen, Grabner-Hagan, Brown, and Mirabelli (1998) found that real time chat tools fostered more responses per student whereas delayed conferencing tools promoted depth and idea evaluation. Not surprisingly, Newman et al. (1996) recommend that the next generation of groupware tools be designed to foster deeper thinking and shared understanding of topics among members of a online group or community. For instance, tools are needed for mapping out key issues, arguments, and positions, voting and ranking issues, and forming and reforming groups. While this study involved topical discussions, they contend that online group projects such as case studies, debates, role plays, and symposia (Paulsen, 1995b; Appendix B) might exhibit Garrison's (1991) five stages even more explicitly. Unfortunately, Web tools with such pedagogical components or features are extremely rare.

Knowledge construction. In reaction to frameworks from Henri (1992), Garrison (1991), Levin and Waugh (1998), Newman et al. (1996), and other scholars commonly used in analyzing computer conferencing transcripts, Gunawardena, Lowe, and Anderson (1997) developed a framework based more on a learner-centered instructional paradigm. Their model defines interaction within CMC as the means for co-construction of knowledge and emphasizes the stages and patterns of knowledge construction that emerge during the online conference. These researchers are interested in capturing both the individual and social acts of knowledge creation. The five phases in the social construction of knowledge in their model are detailed in Table 8 (Appendix A).

There are a number of codes within the phases. The initial study by Gunawardena et al. (1997) involved an online global debate among hundreds of professional distance educators prior to a conference involving participants from 35 countries across time zones. Their analyses of the debate revealed that students were task driven and competitive in attempting to win a debate. As a result, the format of the debate kept participants from the higher levels in the co-construction of knowledge. Student dialogue tended to remain at Phase I with the sharing and comparing of information, instead of elevating to knowledge negotiation, construction, testing, and application. The same findings were evident in a follow-up CMC study of 25 managers of workplace centers in Canada (Kanuka & Anderson, 1998). The authors speculated that this professional development forum was not an ideal opportunity for cognitive dissonance, discord, and heated negotiation of co-constructed meaning; but, instead, participants found greatest value in sharing and receiving information on what each other was doing or found useful. Nevertheless, this model refocuses instructors and designers on the stages in knowledge creation and the need to share understandings of knowledge among CMC participants.

Online discussion analysis. Somewhat similar to Kanuka and Anderson (1998), Curtis and Lawson (1999) designed a scheme for analyzing online discourse. They proposed greater understanding of the types of behaviors typically found in collaborative learning situations—such as giving and receiving help and feedback, exchanging resources and information,

explaining and elaborating on information, sharing knowledge with others, challenging others' contributions, advocating increased effort and perseverance among peers, engaging in small group skills, and monitoring the efforts of others. Their coding scheme categorizes such high level behaviors as planning, contributing, seeking input, reflection and monitoring, and social interaction. In a study of 19 college students completing three online assignments, slightly over a fourth of their online behaviors related to each of the following categories: planning, contributing, and seeking input (see Table 9, Appendix A). Among the more common events were initiating activities, providing feedback, sharing knowledge, seeking feedback, and reflecting on the medium. As in other studies (see Bonk, Malikowski, Angeli, & Supplee, 1998), few students challenged others or attempted to explain or elaborate on their particular positions. Curtis and Lawson (1999) also confirmed common findings of student resistance to peer critique as well as the limited off task behaviors of around 5 percent in such activities (Bonk, Hansen, et al., 1998; Cooney, 1998). They recommend that instructors promote greater online debate perhaps by modeling appropriate ways to challenge others.

Taking a more mathematical approach, Hara (2000) recommends Formal Concept Analysis (FCA) for understanding conceptual hierarchies in e-learning. FCA is based on a mathematical lattice theory that analyzes quantitative data visually. According to Hara (2000), it can be used to describe social relationships. For instance, she used it to reveal complex relationships among categories of coded data in online environments, thereby providing insights into online interactions.

A simpler scheme was used by Hoffman and Elliot (1998) who coded Web dialogue according to the six levels of Bloom's taxonomy. Interestingly, these researchers also coded affective indicators such as supporting comments, affective sharing, values, praise, empathy, and constructive judgments. They found that student Web electronic dialogue occurred at a deeper level than their more superficial written journals. These researchers concluded that case-based discussions on the Web can foster student problem solving, interaction, and the creation of a network of peers with whom to communicate.

Interpersonal considerations. In contrast to critical thinking and metacognition, researchers such as Walther (1992, 1996) are interested in interpersonal aspects of CMC and how interaction changes over time. Walther argues that there is less social information per message in CMC due to limited nonverbal cues. When there is minimal time, limited turn taking, and anonymous posting, CMC groups tend to be more task focused, democratic, and impersonal (Walther, 1996). Over time, users can share ideas and manage relationships, thereby building impressions and interpersonal relationships with each other. Given sufficient time and message exchange, CMC participants can develop similar communication relationships to FTF environments (Walther, 1992). In fact, as group intersubjectivity grows, he posits that CMC environments can develop "hyperpersonal" relationships that might not occur in FTF settings. Individuals engaged in multi-tasking when using chat tools, for instance, experience greater intensity of interaction than is possible in FTF situations, even though most CMC technologies are not prime vehicles for coherent conversations (Herring, 1999; Appendix B). He even finds that the time stamping of a message (night or morning) conveys significant nonverbal cues, thereby affecting one's perception of sender dominance (e.g., talking business during off-hours) and intimacy (e.g., slow replies to a social message) (Walther & Tidwell, 1995). Given the

accumulation of vast message exchanges over time (Slatin, 1993), increasing interpersonal effects are often found in computer conferencing environments (Kang, 1998).

Bakardjieva and Harasim (1997) also argue that well designed educational computer conferences represent an important example where such socially enhanced learning can occur. Given the impact of social interaction on cognitive thought, there is a need to understand the forms of talk—social, cognitive, off-task, etc.—that might evolve during online interactions. These researchers examined both the cognitively charged speech acts (e.g., identifying problems, stating positions, questioning positions, etc.) as well as interactively charged speech acts (e.g., acknowledgments, support, disagreements, etc.) of online discourse in college courses (see Table 10). Three of the most common cognitive acts they discovered were identifying problems, arguing positions, and offering solutions or conclusions. While interactivity was more varied, they found a high level of mutual support, including acknowledgments, encouragement, personal information and feelings, and meta-interaction.

Table 10
Cognitive and interactive acts in online discourse (Bakardjieva & Harasim, 1997)

Subgroups	Cognitive Acts
Interrogation Zone	1. Identifying Problem 2. Exemplifying Problem 3. Introducing Related Problems 4. Linking Problems
Analysis Zone	5. Analyzing Problems 6. New Perspective to Problem 7. Defining Problem
Statement Zone	8. Providing Information 9. Arguing Position 10. Providing Evidence to Justify Position
Critique Zone	11. Comparing Positions 12. Questioning Position 13. Opposing Position
Metacognitive Zone	14. Metacognitive Act
Closure Zone	15. Drawing Conclusion 16. Offering Solutions 17. Challenging Conclusion/Solution

Subgroups	Interactive Moves
Thinkers' Relations	1. Support 2. Encouragement 3. Acknowledgement 4. Building on 5. Negotiation 6. Partial Agreement 7. Disagreement 8. Challenge
Personal Relations	9. Personal Information/Reflection 10. Revealing Personal Feelings 11. Personal Address
Group Relations	12. Coordination 13. Meta-interaction 14. Phatic Communication

Bakardjieva and Harasim concluded that these online conferences blended both cognitive and interactive acts. In effect, students' stated positions while supporting other points of view, questioned positions while inviting others to comment, and drew personal conclusions while building on previous comments. Nevertheless, while there were high levels of mutual support in all groups and some degree of personalization, these same students tended to avoid controversy

and critical attitudes toward their peers. The researchers argued that greater intersubjectivity is needed in online conferences wherein participants agree, disagree, challenge, and negotiate with their peers with whom they share personal knowledge, interests or history.

Sociocultural considerations. Bonk and his colleagues have analyzed computer conferencing and e-learning from a sociocultural perspective (Bonk & King, 1998). The goal of this research is to foster student-student and student-instructor construction and negotiation of meaning by extending the class beyond typical time, geography, and space limitations. In a series of studies, Bonk and his colleagues have looked at the activity setting of these new environments (Bonk & Sugar, 1998; Kirkley et al., 1998). Variables of interest have included the types of talk, forms of mentoring, levels of questioning, forms of participation (Zhu, 1998), patterns of interaction, and levels of scaffolding in various online environments. Their research has revealed that direct instruction is just one of at least twelve forms of online assistance or mentoring (Table 11, Appendix A) provides a scheme for considering the forms of online learning assistance). Across these studies, one senses a a shift away from modeling and direct instruction to task structuring, questioning, scaffolding, and feedback (Bonk & King, 1998; Bonk, Malikowski, Angeli, & East, 1998; Bonk, Malikowski, Angeli, & Supplee, 1998). The instructor role varies tremendously with direct instruction playing a far smaller part than in conventional classroom instruction.

These researchers have also found that pedagogical activities on the Web can foster high as well as low levels of student questioning (Bonk & Sugar, 1998), limited off-task behaviors (Bonk, Hansen et al., 1998; Cooney, 1998), and increasing group cohesive and student-centered environments over time (Hara et al., 2000; Kang, 1998). And while participation patterns change from the regular classroom, discussion is not entirely equal in electronic forums. Nonetheless, in Cooney's (1998) study of a high school English classroom, the quantity and quality of discussion was elevated significantly for all students in an electronic network. At the same time, the limited off task behavior found in Cooney's study and in most of this research may not be a positive finding. In fact, the creation of online communities is difficult since e-learning students are extremely task driven. An additional problem is that student dominance and antagonism is rare. When it does occur or when roles like pessimist and devil's advocate are assigned, there tends to be more social interaction and dialogue (Bonk, Hansen et al., 1998). Not surprisingly, controversial and "hot" topics do provoke the most discussion (Bonk et al., 2000). And while student case discussions online generally lack justification (Bonk, Malikowski, Angeli, & Supplee, 1998), adding students from other countries or universities to the discussions increases the chances for students to link arguments to textbook concepts and terminology. Finally, CMC environments can support the social construction of knowledge (Zhu, 1998).

Conferencing dialogues. In contrast to sociocultural theory, Howell-Richardson and Mellar (1996) analyzed an online course for educational trainers using Speech Act Theory to analyze the conferencing dialogue. Here, they looked at the structural or illocutionary properties (e.g., interrogative, declarative, directive, elicitation), group focus, task focus, addressee, and intermessage referencing. They found that minor changes in the online moderating facilitated vastly different patterns of interaction. Not surprisingly, moderators taking on a role of facilitator with short organizational and group cohesion messages tended to generate more intermessage referencing than moderators who acted as authorities.

These findings are consistent with studies that show that CMC also fosters informal and exploratory conversation (Weedman, 1999) that allows students and instructors to take risks and share knowledge. In a study of 80 college undergraduates, Ahern, Peck, and Laycock (1992) also found that a conversational style of interaction from the instructor produced higher and more complex levels of student participation. When online instructors were more informal and spontaneous in their commenting here, students were more interactive with each other, compared to conditions wherein the instructor simply posed formal topic-centered statements or questions. In effect, responding to teacher questions or statements online is simply an extension of the recitation method; the more teacher-centered the e-learning environment, the less student exploration, engagement, and interaction. As Tharp and Gallimore (1988) demonstrated with their highly acclaimed "instructional conversation" method, students need to be invited into the discourse through many ways of instructor and peer assistance.

Understanding online interaction seems key. Moore and Kearsley (1996) observe the nature and extent of interaction will vary according to the organizational needs, designer goals and teaching philosophies, nature of the subject matter, level of student, media selected, and student location and culture. Garton, Haythornthwaite, and Wellman (1997) argued that examining relations within network groups allows researchers to track how groups form and function. They recommend shifting the focus from individual or small group performance with technology to begin studying social networks. In effect, the unit of analysis for such scholars is the relationship among people. Consequently, they evaluate the content, direction, and strength of relations as well as the ties that connect one or more relations.

While social interaction is often declared vital to e-learning success, scholars have difficulty agreeing on what is interaction (Wagner, 1994). Rafaeli and Sudweeks (1997), for instance, consider interactivity as the extent to which messages in a sequence relate to each other. Their analyses of network conferencing in platforms available to the public (Bitnet, Usenet, and Compuserve) found that slightly over 50 percent of these messages were generally reactive statements, referring to just a single message in front of them. Only around 10 percent were truly interactive. Most messages contained factual statements or opinions while many also contained questions or requests. In contrast to hypotheses that frequent participators would be more interactive, these group members were more reactive than low participators. When messages were interactive, they were more opinionated and humorous, while containing more self-disclosure as well as a sense of involvement and belonging. Not surprisingly, people are attracted to fun, open, frank, helpful, and supportive environments.

Given the above findings, it is critical to understand the degree to which different types of tools and tasks foster the social negotiation of meaning. Just how interactive and collaborative are online environments? It also might be interesting to understand how different interactions impact different types of students and learning.

Learning Styles

Not surprisingly, scholars are curious whether different ways of perceiving and processing information can impact student success when learning on the Web. Given the fact that not all students learn the same—some prefer stories, some observation, some hands on

experience, etc.—there is growing interest in how the Web facilitates learners from distinct learning styles and forms of intelligence. Nelson (1998) argues that different Web tools facilitate different types of intelligence. For instance chat tools might address interpersonal and linguistic intelligence. In contrast, computer conferencing tools might foster linguistic, spatial, and interpersonal intelligence, whereas e-mail might play a similar role but also influence intrapersonal intelligence. Finally, class Web sites might address nearly all forms of intelligence by incorporating video and sound clips, games and simulations, class notes, graphics, tutorials, etc. Unfortunately, as noted twice before, most class Web sites utilize fairly basic technologies.

In terms of the impact of e-learning on different learning styles, one must keep in mind that extensive hypermedia research from the early 1990s had mixed results. Dillon and Gabbard's (1998) review of the literature included one study where field independent learners outperformed field dependent learners on all tasks. Other studies showed differences in cognitive styles and learning time, locations visited, and tasks completed. However, Shih et al., (1998) found no differences in learning styles on the Group Embedded Figures Test and Web-based learning achievement. And while Reed and Oughton (1997) determined that field dependent learners tend to take more linear learning paths in comparison to the nonlinear navigation of field independent learners, such differences dissipated over time. In Kerka's (1998) brief review of the research, she indicated that field independent learners tend to perform more efficient searches, take less time, and are more comfortable in open-ended Web environments, whereas field dependent learners may require site maps and global overviews. Since the Web is a hypermedia environment, all these studies have relevance here.

It is important to know where different types of learners spend their time in Web environments and succeed in learning (Kim, 1999). How often do different types of learners use a particular tool or Web site (i.e., what are their navigation paths)? How much time is spent at each node or completing each task? And how much structure might improve learning for different types of learners? These and other questions leave many gaps in understanding e-learning.

Online Communities

As a large and complex organization, the Army has many communities, from installations, branches, and career fields to year groups, special interest groups, and veterans clubs. An informal examination of military chat rooms on the Internet revealed over 53 active rooms (Olson, personal communication.) A challenge is to channel these natural interests in organizational communities into learning communities that can enhance the development of skills and acquisition of knowledge by soldiers. This section examines the literature on the formation and membership of learning communities in educational settings, provide examples, and considers the online class as a learning community.

There is a huge void in the research regarding how online learning communities are formed. In a 1994 Presidential address to the American Educational Research Association, Brown (1994) outlined key learning principles of the cognitive revolution of the past thirty years. She also pointed to the need for active and reflective learning in a community of discourse and community of practice. Brown argued that "Learning and teaching depend on creating,

sustaining, and expanding a community of research practice. Members of the community are critically dependent on each other. No one is an island; no one knows it all; collaborative learning is not just nice, it is necessary for survival" (Brown, 1994, p. 10). It is time to explore how new technology environments can facilitate the formation of such communities.

Not only does learning theory indicate a need for online communities, but there are many practical reasons as well. For example, the President of the University of North Carolina, Broad (1999) points out that the formation of communities is one of the key indicators of high quality education in residential college settings. Since the most powerful learning in university settings is achieved in faculty-student and student-student interactions and mentoring situations, Broad asks how those learning community features can be replicated, extended, and transformed from a distance. She also asks what levels of interaction are desirable and essential and how the levels of interaction might differ by domain and institutional level?

Despite such prodding, minimal research exists on the technological and pedagogical variables needed to foster virtual communities. Research proposed later in this paper is intended to address this gap in the literature. Unfortunately, even as institutions and instructors hurriedly place courses on the Web, the tools for e-learning interaction are not fully developed and thought out (Hughes & Hewson, 1998).

Designers of online training and education need to understand the factors underlying successful online learning communities. A number of scholars have begun to describe the factors. For example, Bielaczyc and Collins (1998) argue that learning cultures need membership with diverse expertise, mechanisms for sharing one's learning, common goals that help continually advance its collective knowledge and skills, and a value on learning how to learn. Each member may have different knowledge or identities that the online community should advertise and utilize. There also is a common language or socially shared knowledge base for describing and promoting ideas, processes, plans, and goals. Through shared discourse, members formulate and exchange ideas. The tools developed, therefore, should help in advancing learning.

Unlike most research on learning, there is a dual focus here on both individual knowledge growth and joint products or collective efforts. From such a perspective, it is important to identify the factors that foster or negate community building in e-learning environments. How are learning communities designed and supported? What technology tools support distributed interactive learning communities? How can distance learning technology be used to build online communities (Hiltz, 1998)? Should similar design principles and tools be used in both training and education environments? How might they differ? Answer to these questions will not come without significant research inquiry and support.

Community Membership

Before online communities can be understood and supported, it is vital to know what qualifies as a community. Community psychologists suggest that there are four key factors for a sense of community: (1) membership, (2) influence, (3) fulfillment of individual needs, and (4) shared events and emotional connections (McMillan & Chavis, 1986). In terms of membership, a sense of belonging, community boundaries, identity, and personal investment all contribute to

membership in a community. Membership also tends to create a sense of cognitive dissonance associated with one's responsibility to sacrifice for the community, thereby enhancing member confidence, sense of entitlement, and loyalty to the group (McMillan, 1996). The second key factor, influence, may include influencing the community as well as being influenced by it. The notion of influence also instills some pressure for uniformity and conformity that spurs even greater member closeness. Third, communities provide rewards and reinforcers that fulfill personal needs and are critical to staying within the community. Fourth, members have emotional bonds from shared histories that connect members and encourage continued investment and involvement in the community. McMillan and Chavis, in fact, developed a sense of community model that summarizes how the subelements work together to create and maintain communities. To test theories and models, there are "Sense of Community" scales and indices to determine the relative influence of each factor (Chavis, Hogge, & McMillan, 1986).

Based on the above model from McMillan and Chavis (1986), Chao (1999) recently designed a categorization scheme for online communities. Online indicators of factor one—membership—include self-disclosure statements, acknowledging other's membership, the paying of dues in terms of time and energy, references to the boundaries of the community, and attempting membership. Online influence might occur when referring to norms, rules, laws, or other orders, attempting to influence or persuade others, being influenced by others, and identifying and trusting some authority. Fulfillment of individual needs is found when one is attempting to find common ground, express a personal need, thank or acknowledge someone for needed information, give and receive information, or voice criticisms, suggestions, or differences of opinion. Finally, sharing events and emotional experiences as well as identifying the spiritual bond of the group might occur when referring to stories of what has happened in the past and using special symbols or language specific to members of the group. While still in the development phase, such a categorization scheme might eventually help identify events that contributed to the development of an online community in both training and education settings.

It is important to not only advance the types of tools for building virtual learning environments, but there also is a pressing need to investigate how online communities are formed and sustained. What does an online learning community do? What are the key principles that help create a sense of learning community (Barab & Duffy, 2000; McMillan, 1996; McMillan & Chavis, 1986; Schwier, 1999)? Schwier argues that electronic learning environments too often fail to develop a community of learners. He then provides the following seven guidelines for the development of virtual learning communities:

1. Historicity Element: Incorporate prior experiences and stories of members, explicitly share the culture and values of the virtual community, and make public the history of the community.
2. Identity Element: Foster team-building activities, develop community logos, publicly acknowledge accomplishments of groups and members, and articulate the community focus, purpose, and requirements for membership.
3. Mutuality Element: Include group exercises, assignments, and activities that require each member to contribute to the final product, while also inserting questions and guidance that encourage members to share solutions and invest in each other's ideas and concerns.

4. Plurality Element: Encourage membership in and participation from groups and professional associations related to the learning focus, including those from other countries or locales pursuing similar goals and issues.
5. Autonomy Element: Within group identity, it is vital to foster individual expression, promote respectful communication of ideas, and create strategies for settling disputes and reaching consensus.
6. Participation Element: Allow group members the chance to shape learning agendas, while guiding the participation of new members, promoting individual or group exploration outside of the key learning focus, and encouraging risk and outside lurking.
7. Integration Element: Articulate a common set of beliefs or group norms as they emerge within a learner-centered philosophy and pedagogy that celebrates individual accomplishments while building group identity and momentum.

Communities, Schwier (1999) argues, are collections of people bound together by some common reason. A learning community, therefore, is a group of individuals who are interested in a common topic or area and who engage in knowledge-related transactions as well as transformations within it (Fulton & Riel, 1999). A community of learners is apparent when learners know and value each other, discuss common interests, support each other's needs, share control and responsibility, and take risks in a trusting atmosphere (McLoughlin & Oliver, 1999). They take advantage of the opportunity to exchange ideas and learn collectively. He further contends that certain conditions need to exist for nurturing a learning community such as a leader setting the tone, transparent technologies to foster task completion and the development of interpersonal relationships, a safe and comfortable environment for participation, and an emphasis on narratives and story telling. He then describes how these elements play a role in the formation, maturation, and decline or metamorphosis of the learning community.

Kulp (1999), in a white paper related to LearningSpace from IBM, suggests the need for goals and milestones for the group to work toward. In effect, those in the learning community need to build, problem solve, invent, create, and co-learn. Both experienced learners and novices should support each other through interaction and negotiation of ideas. Novices might take on more of an observer role initially as they are apprenticed into the community of practice. A novice gradually appropriates the skills necessary for him or her to become a competent and skillful member of the community. He or she becomes acclimated to the setting by observing as a legitimate peripheral participant within the community and gradually taking on a more critical role (Lave & Wenger, 1991). Such newcomers eventually become old-timers. In essence, a community of practice is a place wherein resources and specific expertise are shared and made accessible to others.

The learning community must bring people together for some initial common interest or quest; e.g., sharing, problem solving, collaborating, or learning. Similarly, there is a need for a common reference point for the online group as well as multiple entrance points (Duffy, McMullen, Barab, & Keating, 1998). The cultural and historical heritage of the community of practice will normally include shared goals, opportunities for negotiating ideas, and common practices or rituals (Barab & Duffy, 2000). When those components are in place, there is greater opportunity for individuals to function within an interdependent system and for new members to work beside and learn from more competent members. New members inherit the goals,

practices, and rituals of the previous members, and, over time, such newcomers will replace the old timers. So, there are some common goals and values, feelings of commitment and trust, and something valuable that binds the participants. In addition, members must have opportunities to contribute to and develop the online community. As such, members of the community have influence on the direction of the community and new membership.

Online Learning Community Examples

So, how does one create an online learning community? Barab and Duffy (2000) indicate an initial need for a mission statement, purpose, or common reference point. Second, there must be meaningful membership wherein one's questions and needs are addressed and members can learn about each other. At the same time, there usually is some type of learning facilitator or conversational guide that focuses and refocuses the group. In addition, online communities benefit from separate spaces or rooms for sharing information and for socializing and creating interesting spaces. For example, there might be regularly scheduled types of events in those rooms or meeting halls. One might also change the Web site to connote seasonal changes during the year or provide other means for the feeling of time passages. New or prospective members also might be guided within the site with chats, tours, and visitor guidelines that welcome them to the online community. Members might even hold positions or responsibilities within the different areas of the community.

TAPPED IN is an environment for teacher professional development and informal collaborative activities (Schlager & Schank, 1997). This resource combines opportunities for informal and formal learning that emphasized collaboration and social interaction within a supportive community of practice. In the late 1990s, there were over 6,000 K-16 teachers, staff, and researchers within the TAPPED IN environment. Here, teachers with diverse skills and interests can meet at any time, learn about many educational reform ideas and approaches, and find useful materials and resources (Appendix B). Members hold real-time discussions and classes, browse Websites collectively, explore professional development options, and interact via mailing lists and discussion boards all in a single venue. Instead of heavily relying on video conferencing or asynchronous discussions, TAPPED IN is primarily a synchronous environment relying on a multi-user virtual environment. Filled with different floors, offices, and meeting rooms, members can name and furnish these rooms, create and share documents and hyperlinked objects, and post items in their own workrooms. By employing Java technology, TAPPED IN rooms are dynamically and continuously updated by the participants of the community. In effect, TAPPED IN helps overcome teacher isolation by providing a rich sharing of experiences and resources while also recognizing and rewarding participant achievements. In addition, it is a generally safe and supportive environment for learning.

Online Classes as Learning Communities

In contrast to the permanent environments such as TAPPED IN, Barab, Thomas, and Merrill (1999) analyzed how a sense of community might be formed in an online graduate course in adult education. The instructor of this particular course was explicitly intending to create an online learning community, instead of an environment wherein the instructor dictated the content. Consequently, the course modules included opportunities for collaborative explorations and shared personal experiences. Barab et al. (1999) found that online courses can support the development of a learning community when they (1) can flexibly accommodate diverse learner

needs and interests; (2) foster the co-construction of meaning through information sharing; (3) allow for student stories which are personal or filled with self-disclosures; and (4) create a positive, warm, and psychological safe environment for learning. They also point out that, according to the adult education literature, it is important for learners to apply course content to their lived experiences and personal situations. This was crucial to the emergence of a learning community here since student identity and personal development could co-evolve with course participation and increasing competence with course material. Qualitative analyses of student posts and later member checking indicated that the design of an open, flexible, and inviting climate for learning was central to the evolution of this community. The authors caution that courses involving less personal material or more technical content may not foster as much personal interaction and sharing of experiences.

What about more technical courses? Phelps, Ashworth, and Hahn (1991) discovered that asynchronous computer conferencing in military settings can increase student camaraderie, cohesion, connectedness, and sense of accomplishment. Such consistency in training and education environments is an important finding.

In attempting to foster a professional development community, Kanuka and Anderson (1998) developed a survey instrument wherein participants were asked to indicate their agreement with statements related to the construction of knowledge and the creation of online learning communities. Similarly, Bonk, Oyer, and Medury (1995) created an instrument to explore the degree of social constructivism students and instructors perceive and prefer. Table 12 (Appendix A) combines items from these two scales to create an entirely new scale, the "*Social Constructivism and Learning Communities Online*" (SCALCO) scale for measuring student online learning. Understanding student perceptions of the constructivist nature of the e-learning environment may prove informative to both researchers and instructors. Just what aspects of a Web course are critical for creating a learner-centered environment? Is there a gap between instructor and student perception of the learning environment and between reality and ideal world? Will training or education e-learning environments be deemed more constructivistic in nature than traditional classroom settings?

In a more recent study, Rourke, Anderson, Garrison, and Archer (2000) pointed to ways for fostering knowledge construction through critical, reflective discourse. They explored the social presence or ability for participants to project themselves socially and emotionally into the online community. Factors coded for social presence here included reinforcing behaviors (e.g., complimenting, expressing agreement), interactive behaviors (e.g., continuing a thread, quoting from other messages, explicitly referring to other messages or others by name, asking questions, and referring to the group as a whole), and affective behaviors (expressing emotions, humor, salutations, greetings, and self-disclosures). Rourke et al. found approximately 20 interactive behaviors and 12 affective behaviors for every 1,000 words of text, but only about 2 reinforcing behaviors for comparable text space. Continuing a thread, referring to others by name, and self-disclosures were the most common indicators of social presence. They recommend that for a critical yet respectful environment, e-learning must be open, trusting, close, warm, and personal. Yet, from their standpoint, CMC groups must not get too close, as there still must be a level of tension to foster cognitive conflict and critical questions. Instructional decisions concerning e-learning definitely are not easy.

As is evident, researchers are just beginning to ask questions and engage in research related to online learning communities. Many questions about virtual learning communities remain (Chao, 1999). For instance:

1. What conditions foster online learning communities? What social structures must be in place?
2. At what point does the learner or participant become part of the community?
3. How can CMC environments substitute for the social cues of FTF environments that help foster a sense of community?
4. When and how do students develop a sense of online communities within both training and higher education classes? What principles, practices, and tools spur the growth of learning communities?
5. How does the development of a learning community relate to student perceptions of course tasks and activities?
6. Does the formation of new relationships relate to the depth of student learning?
7. How do instructor styles, student experiences with e-learning, and course materials contribute to the development of an online community?
8. How do such characteristics as trust, support, openness, knowledge sharing, negotiation of meaning, and influence emerge and evolve?
9. How do permanent learning communities differ from temporary classroom-based learning communities?
10. Why do people use a site? Why do new people join the asynchronous learning network? What motivates their participation? What are their expectations?

In addition to the questions above, it is important to understand the tools that positively impact the sharing of information and mutual understanding of participants. How do online tools provide a shared social space for instructor and student interaction? Just how do participants share knowledge and experience? What must be present in the learning community for significant knowledge negotiation? As indicated by the research studies suggested later, most of these questions have yet to be addressed.

Other Variables of Interest

In addition to those variables mentioned earlier, there is growing interest in navigational strategies, learning strategies, self-efficacy, self-concept, and goal stability. For instance, in examining verbal protocols through a hypermedia database, Yang (1997) created a classification scheme for information evaluation and management as well as eight types of information searching and retrieving behaviors (e.g., prescriptive, exploratory, intuitive, accidental, curious, purposive, and tangential). She suggests future research explore how the online task influences the types of learning strategies selected by learners and the patterns of information searching. In terms of collaboration, Yang recommends studies such as comparing the learning strategies and interaction patterns of online learners when collaborating to solve a problem versus collaborating to write a report. For instance, researchers might document the types of learning strategies invoked when solving problems—basic (i.e., repeating information, copying, underlining, etc.) or complex (e.g., paraphrasing, summarizing, grouping, developing outlines or hierarchies, etc.).

Before such questions can be answered, pedagogically relevant tools must be designed Rich Lehrer and his colleagues (Lehrer, Erickson, & Connell, 1994) argue that it is important to build tools that engage students in planning, transforming, evaluating, and revising their knowledge. Based on learner-centered principles, Lehrer (1993) suggests that students design knowledge instead of receiving information passively. Importantly, he has created a scheme to analyze the cognitive components of hypermedia design (defining problems, selecting information, organizing and representing information, evaluating designs, and revising the design). In his HyperAuthor tool, students create and label their links, design graphs and animations, and generate extensive text. Such pedagogical tools are lacking in online learning today.

Research on Internet-Based Distance Learning

Distance learning refers to structured learning that takes place without the physical presence of the instructor. All service branches are active in the implementation of distance learning technologies to replace traditional classrooms for both active and reserve components (Metzko, Redding, & Fletcher, 1996). A recent report by the Army Research Institute documented the anecdotal nature of research on distance learning in training (Wisher et al., 1999). Overall, research in distance learning often finds that there are no significant differences in student learning and performance from more conventional learning environments. In fact, there is an online report documenting non significant results of distance learning research since 1928 as well as a scant few studies that actually indicate some positive and negative differences (Russell, 1999, Appendix B). Rather than examining that literature any further, the current review will present recent findings in education on Internet application of e-learning and collaboration tools as applied in distance learning.

E-Learning Tools

Some research reports are less positive about e-learning than others. Hara and Kling (2000), for instance, received extensive press regarding their qualitative findings of student anxiety, frustration, confusion, and lack of support in an online graduate education class. They suggest that high quality e-learning may only be possible when there are highly dedicated and experienced teachers in this labor intensive business. Problems occur when student time and effort is not rewarded with feedback, grades, or other rewards. There are also a number of studies showing high rates of student dropout in distance learning caused, in part, by the lack of social cues, interaction, and clear expectations (Abrami & Bures, 1996). Additionally, some studies show problems with group leadership including domination and unresponsiveness of some online group members (Scrifres, Gundersen, & Behara, 1998). In one study, library science students rebelled against hypertext-based instruction delivered entirely over the Internet (Harris, Harris, & Hannah, 1998). Even extremely competent and dominant students were uncomfortable with collaborative and electronic texts. They experienced difficulty, disorientation, disjointedness, and confusion with the digital course. In contrast to e-learning prophecies, these students were extremely open about their love for books and trust of paper, not online collaboration tools.

Some findings are more mixed. For instance, using questionnaires, focus groups, and structured interviews, Small (1999) documented that simultaneously working and attending

college classes is more difficult for resident than distance learning students, despite more time spent studying for distance education students. She also found greater time demands for faculty in e-learning situations. Among her recommendations were utilizing more flexible learning modes for part-time students and using simple communication tools such as email wherever possible. She also suggested embedding technologies that enhance student-student interaction and rapport with instructor, building experiences for interpersonal bonding, creating policies for faculty time commitments, and having successful faculty model and demonstrate e-learning activities and uses for others.

Owston (1999) employed both quantitative and qualitative tools in analyzing four different online projects. Using structured interviews, the first study found positive benefits of online mentoring within writing while teacher use of a two-way television channel for searching and selecting math and science videos had more limited success. Interestingly, Owston notes that clustering network-based research projects that have similar goals is more cost efficient since evaluators can often make simultaneous use of the same collection methods, instruments, procedures, and staff. A second study of online tutorial help in an introductory computer technology course relied on focus groups, semi-structured interviews, field observations, and computer log files analyzed by WebTrends Log Analyzer software. Triangulation of these data revealed that students did not make extensive use of the tutorials, but those that did found them useful, easy to navigate, and motivational. A third study comparing students at one college taking courses via the Web, live instruction, or correspondence, found that the Web and FTF courses, not surprisingly, were superior to correspondence courses in terms of course achievement. While cautiously presented, the Web courses showed significant achievement gains to FTF if students who failed to complete the course were removed from analyses. A fourth study used transcripts of e-mail and online chats, group interviews, and language assessment tools to evaluate an English-as-a-second-language course for adults. While this particular course proved effective, the initially small enrollment of 14 students was perhaps not as cost effective.

One recent report in the Chronicle of Higher Education (Carr, 2000b; Appendix B) revealed that while Web students in a psychology course consistently scored five points higher on final exams, they were less satisfied with the course than traditionally taught students. The researchers point out that while students in the FTF course tended to study the night before an exam, students in the Internet course had to space out their studying practices. The e-learning students also were in an environment where professors could respond to their needs on demand. Similarly, Davies and Mendenhall (1998) found no significant differences between online and classroom students in a fitness and lifestyle management course, but most preferred a classroom experience. They felt live instruction provided more entertainment, friendships, and structure than online experiences.

In addition to various negative or mixed e-learning findings, there are some promising aspects to e-learning. In general, distance learners have more positive attitudes toward distance learning than traditional learners (National Center for Education Statistics, 1999). An early study of online environments by Hiltz (1990) also revealed some advantages of online over traditional such as greater access to professors, increases in participation, higher course satisfaction, equal or superior mastery of course material, and enhanced interest in subject

matter. Hiltz admitted that such gains rely on having motivated and prepared students with adequate access to technology. More recent findings do confirm that distance learning students tend to be more intrinsically motivated and internally controlled (National Center for Education Statistics, 1999).

More recently, Stefl-Mabry (1998) found an increase in reading comprehension for college students in a Web-based "Introduction to Reading" course over students in a traditional version of the course. In college economics courses, Agarwal and Day (1998) discovered that Internet enhancements raised student attitudes, performance on exams and course grades, and student attitudes toward economics. In another study of college students, students who were active in an optional computer-mediated communication (CMC) exercise also received higher course grades (Althaus, 1997). However, it was unclear whether this was truly due to learning in the course or preexisting differences.

Collaborative Tools in Distance Learning

There are both positive and negative effects related to collaborative tools. For instance, even though students can participate at any time, this technological advantage also places more requirements on the instructor to be responsive at nearly any time (Ottenhoff & Lawrence, 1999). Whereas online discussion forums can provide unique venues for public reflection, they can also become filled with careless and thoughtless entries. Along these same lines, online forums can be opportunities for students to debate and negotiate arguments or a place wherein the instructor has the ultimate final word. In effect, online collaboration tools can be utilized for significant change in adapting student-centered approaches or they can continue fostering a more passive learning approach. Clearly, the technologies alone will not change the educational process. Innovative, planful curricula that structures online interaction for meaningful and authentic learning experiences increases the chance for successful, student-centered learning (Riel, 1990).

Merisotis (1999) points out that since distance learning technology will continue to play a significant role in teaching and learning, the focus should shift from whether it makes a difference, to where it makes a difference as well as which approaches might have more powerful impacts in terms of student learning. Stephen Ehrmann (1999, p. 51) adds that "the real debate needs to focus on identifying which approaches work best for teaching students, period." Of course, a focus on learner-centered instruction and pedagogy might create more avenues for new e-learning technologies to be deemed effective. Even the findings of extensive cost and performance analyses of large-section college classes taught online such as those at the Sloan Center for Asynchronous Learning Environments (SCALE) at the University of Illinois can be reduced to one common finding—online courses need sensible pedagogical approaches that allow students opportunities to communicate their learning (Arvan, Ory, Bullock, Burnaska, & Hanson, 1998).

Educational Websites

Just as the debates about the impact of distance education on student access and learning are inconclusive, so too are the reviews of educational Websites. As noted earlier, instructors tend to employ simple tools online. A study of 436 educational Websites by Mioduser, Nachmias, Lahav, and Oren (1998) demonstrated that instructors and students utilize extremely limited communication and interaction tools, such as e-mail. While simple tools can help ease

the frustrations and tensions faced online, they typically do not offer many opportunities to negotiate meaning and counter ideas. In the Mioduser et al. study, tools for facilitating work groups, learning teams, and learning communities were virtually nonexistent. Such findings are epitomized in their conclusions that for every "one step ahead for technology," there are "two steps back for the pedagogy."

In reviewing college syllabi posted at the World Lecture Hall (Appendix B), Cummings et al. (2000) similarly found that few faculty utilized the numerous interaction and collaborative possibilities of the Web. For instance, few instructors embedded opportunities for practitioner and guest expert interaction. Instead, most syllabi were marked by one-way flows of information from instructors to their students. Yet, according to research by Hiltz (1998), collaborative learning and interaction are vital to the success of asynchronous learning networks. She concludes that "Colleges and universities ought to be concerned not with how fast they can 'put their courses up on the Web,' but with finding out how this technology can be used to build and sustain learning communities" (p. 7). In addition to fostering online course sharing and collaboration, Web tools have the potential to promote new partnerships and build efficiencies in course offerings (Page, 1999).

There is little indication that such debates will subside soon, but one thing is certain--Web technologies can be used in profound as well as extremely trivial and careless ways (Ottenhoff & Lawrence, 1999). Those researching collaborative learning tools and online social interaction, both in training and education environments, are making serious attempts to find the more profound and meaningful uses.

Survey and Evaluation Tools

One common evaluation tool in distance learning is the student and instructor survey. In brief training sessions, a short self-evaluation can offer the most cost effective and informative tool (Wisher & Curnow, 1998). Such tools might foster dynamic changes in instruction. Self-evaluations are faster, less costly, more convenient, and offer comparable data to more objective measures, particularly in military training environments (Curnow & Wisher, 2000). In corporate training environments, evaluation often focuses on practical data such as product surveys, usability analyses, hands-on daily usage logs, and pilot tests (Sokolov, 1999). Some researchers have used Likert scale surveys of student course satisfaction to evaluate online courses. For instance, Schlough and Bhuripanyo (1998) examined the clarity, relevance, accuracy, organization, and sequence of content as well as the effectiveness or graphics and design in meeting student needs.

In evaluating two technologically delivered graduate programs at Nova Southeastern University, Hessler and Kontos (1996-97) surveyed the technological support provided by the campus, preexisting student computing backgrounds, and their ability to use and participate in different media in the program such as the electronic classroom, online research tools, and electronic mail. In using conceptual framework for evaluating for distance education teaching, Cheung (1998) developed a 35 item questionnaire involving (1) student development, (2) assessment, (3) learning materials, and (4) FTF components. Similarly, a 25 question distance education evaluation device from Spooner, Jordan, Algozzine, and Spooner (1999) examined the course, instructor, organization, teaching, communication, and the overall experience.

Such surveys indicate that positive learner perceptions of interaction are critical for e-learning success (Fulford & Zhang, 1993) as are self-motivation and self-discipline (Gifford, 1998). Other research reveals that students feel that online courses take more time than conventional courses but that detailed timelines and external support such as imposed deadlines help them complete these courses and tasks (Mory, Gambill, & Browning, 1998). Not surprisingly, students in control conditions without exposure to such technologies evaluate the potential of e-learning environments less favorably (Usip & Bee, 1998). As the e-learning education and training continues to grow, there will be even greater need for standard and adaptable online surveys. The Internet can offer quick turnaround and reduced costs for conducting evaluations (Kronholm, Wisher, Curnow, & Poker, 1999).

Affective constructs. In addition to cognitive strategies, distance learning impacts many affective constructs. For instance, Hill and Hannafin (1997) hypothesized that students with higher self-efficacy will not only be more confident in using the Web, but they will take more risks. Using subject surveys and simulated post search interviews, their research indicated that students with higher self-efficacy engaged in more strategic behaviors and at higher levels than low self-efficacy participants. Such students also were more exploratory and felt more in control of their learning. These researchers argued that metacognitive knowledge, perceived orientation or awareness of location within the system, system knowledge, and prior knowledge of the subject also influenced success in learner-centered, open-ended environments.

While a popular study found that greater Internet use lowered participation in family activities and communication while increasing feelings of loneliness and depression (Kraut, Patterson, Lundmark, Kiesler, Mukopadhyay, & Scherlis, 1998), it is important to ask whether increased distance education course experience harms student psychological well-being. In addition, how does such e-learning coursework impact academic self-concept? Research from Gibson (1996) indicates that academic self-concept seems to play a significant role in student persistence and ultimate success in distance education. According to her work, clear instructor expectations, ready access to faculty, control over learning, and other support mechanisms positively influence student academic self-concept in distance education environments. From such research, it is clear that external support mechanisms seem to be crucial to e-learning success.

Researchers are beginning to ask whether such support must come from instructors or if peer support can be as effective? In comparing instructor-student e-mail feedback, system-student feedback, and student-student online feedback, Rada (1998) found that students were more satisfied with the distance learning experience when peers or instructors responded to their work than when a database management system provided the feedback. In this study, student-student interaction, instructor monitoring, and quality control tended to produce the most favorable student evaluations. Since peer feedback was as effective as that from the instructor, he concluded that the instructor need not be the only form of online feedback.

While this section details a number of recent e-learning studies, it is far from exhaustive. It is also important to describe research related to developing online communities.

Research Gaps

There is a pressing need for more research on e-learning environments (The Report of the University of Illinois Teaching at an Internet Distance Seminar, 1999). Davenport and McKim (1995) note the dearth of qualitative research and naturalistic studies of groupware and collaborative tools. A combination of qualitative and quantitative research, however, may help understand the mixed results that are far too common in comparative studies of distance learning (Scrifres et al., 1998) while identifying areas of impact, instead of providing yet another study with no significant differences. There is a shift from focusing on how individuals function in different types of groups and within different activities, to targeting the group itself as the unit of analysis (Dillenbourg, Baker, Blaye, & O'Malley, 1996). What types of interactions, explorations, negotiations, and explanations within the group impact individual and group performance? Key questions remain related to how students construct and negotiate meaning in online collaborative environments (Warschauer, 1997) as well as the role of the instructor in such environments. Experiments designed to address some of these issues is provided below.

Ten Primary Experiments

The educational literature has been reviewed. Based on the findings relevant to the Army's transformation to a soldier-centric learning model, the following ten experiments form a research framework for adapting educational tools to training environments. They are not listed in order of importance nor are they suggestive of the order in which they might be conducted. Each experiment is first described by a narrative description that extracts findings from the literature and then in a tabular form identifies the key independent and dependent variables for testing in an Army setting. Each experiment can be conducted in a future Army distance learning program or a similar program in another service. Depending on the specifics of the program and e-learning environment under investigation, the variables might need to be extended, reduced, or otherwise modified to suit a particular training environment. Any of the experiments suggested here must of course be further developed with a complete research or evaluation plan.

As indicated earlier, much of the research evidence for the training effectiveness of distance learning has been criticized as being anecdotal, poorly controlled, and not supported by adequate experimental designs (Wisher & Champagne, 2000). Such practices leave too much room for potential threats to the internal validity of the study. For example, some studies do not take into account a mortality effect in which students with less ability, motivation, or time may become discouraged and drop out during the program so that the average posttest knowledge scores are higher than the average pretest scores for reasons other than the treatment. As identified in Champagne and Wisher (2000), experimental design practices that include comparison groups, random assignment of students, and multiple outcome measures should be included wherever possible. The experiments described below are those that can most immediately guide the Army in adapting promising e-learning technologies to training environments.

Criteria for developing the experiments included an implicit assumption that certain tools demonstrated successfully in education applications are likely to be of benefit in military

training. Proposed experiments are designed to foster near-term technology application and not basic research. The research strategy, then, is to design research to satisfy Army schools requiring or planning collaborative learning environments, and to develop experiments that advance the development and adaptation of educational technologies to meet those Army needs. The initial candidates for application are the Armor Captains Career Course (CCC) and the Field Artillery CCC. Several research efforts should directly support collaborative learning in distance learning versions of these courses. The first experiment among the ten proposed below has the highest potential payoff. The others, while interesting, have no obvious near-term Army payoff.

Experiment I. Online Discussion: Online Officer Training Program

Cummings (2000) notes that online discussions allow participants to reread statements, prepare positions and rebuttals, exchange ideas, and interact with peers, while providing a permanent record of the discussion. In this experiment, students in an online training program, such as the first or second phases of a Captains Career Course, will be assigned to one of four groups during the asynchronous component of the course: (1) discussion with preassigned roles with equal pro and con positions; (2) discussion with student selected roles; (3) discussion with a few assigned controversial roles (e.g., devil's advocate, pessimist, etc.); or (4) discussion with no roles. A control group should also be used. Depending on the size of the class, there may be subgroups within each treatment. Variables explored will include how the form of discussion impacts the depth of student discussion as measured through content analysis techniques. Will students simply share personal ideas or negotiate ideas and eventually compromise on positions? The main hypothesis is that specifically assigning student roles that foster cognitive conflict, as in Groups 1 and 3, will foster more social interaction and negotiation of meaning. These groups will also learn the most. A second hypothesis is that self-regulated learners will more extensively participate in the discussion; especially in Group 2. Third, students in Group 2 will also have the highest attitudes about the discussion activity. A fourth hypothesis is that Group 4 discussions will be at the surface level and will quickly die out. An alternative or follow-up experiment would have two forms of discussion (assigned and unassigned roles) and two forms of communication (synchronous and asynchronous). The first hypothesis here is that students in the synchronous discussion with assigned roles will likely be more task focused than students in the real-time environment without roles. Second, students in both synchronous environments may form relationships more quickly than students in the asynchronous environments (Walther, 1992). Third, the synchronous discussion will have more ideas, whereas the asynchronous discussion will have more reflective, integrative, and evaluative comments.

Initial experiment: Asynchronous communication in assigned roles.

Independent variable: Group membership (5 levels).	Dependent variable: Impact of discussion form on depth of student discussion.
1. Discuss with pre-assigned roles with equal pro and con positions. 2. Discuss with student selected roles. 3. Discuss with a few assigned controversial roles (e.g. devil's advocate). 4. Discuss with no roles. 5. Control (no discussion).	• Degree to which students simply share personal ideas? • Degree to which students negotiate and eventually compromise? • Depth of learning as measured by content analysis.

Hypotheses:
1. Specifically assigning students roles that foster cognitive conflict (Group 1 and 3) will foster more social interaction and negotiating of meaning.
2. Groups 1 and 3 will learn the most.
3. Self-regulated learners will participate in the discussion more extensively, especially in Group 2.
4. Group 2 will have the strongest attitudes toward the discussion activity.
5. Group 4 discussions will be at the surface level and will quickly die out.

Follow up experiment: Synchronous and asynchronous communication in both assigned and unassigned roles.

Independent variables:	Dependent variables:
A. Form of communication (2 levels). 1. Synchronous. 2. Asynchronous. B. Form of discussion (2 levels). 1. Assigned roles. 2. Unassigned roles.	A. Degree of task focus. B. Speed of relationship formation. C. Depth of communication. D. Transfer to a measurable learning outcome.

Hypotheses:
1. The synchronous discussion group with assigned roles will be more task focused than the synchronous group with unassigned roles.
2. The subjects in both synchronous groups (assigned and unassigned) will form relationships more quickly than subjects in the asynchronous groups.
3. The synchronous discussion groups will generate more ideas, whereas the asynchronous groups will be more reflective, integrative and evaluative.

Theory:

Cummings (2000) notes that online discussions allow participants to reread statements, prepare positions and rebuttals, and interact and exchange ideas with peers, while lowering anxiety about peer positions and providing a permanent record of the discussion.
Walther (1992) found, that synchronous environments foster quicker relationship formation than asynchronous environments.

Experiment II. Variations in Instructor Moderation: E-Learning Environments

The instructor plays a critical role in online training environments. Research to date indicates that in e-learning environments, instructors need to shift from traditional lecture-based approaches to being facilitators of learning. But how do instructors foster student social interaction and knowledge construction online? How can instructors raise the level of online questioning and interaction? How can instructors help move learners from being information receptors to actively interpret, question, challenge, inquire, create, discuss, and negotiate ideas? What types of online supports are needed to move learners from simply assimilating archived knowledge to places wherein students personally construct their own personal and group knowledge (Dede, 1996b)? A survey tool on teaching metaphors (i.e., instructor as coach, expedition leader, etc.) will be developed and used to determine the type of instructional approaches adopted online. Instructors in five classes will be provided with training materials on

different types of online teaching approaches: (1) instructor as guide; (2) instructor as host or friend; (3) instructor as provocateur; (4) instructor as teacher or knowledge provider; and (5) a combination approach. Online transcripts will be coded to determine the type of instructional style employed online and then compared to the training. Just what forms of instructional scaffolding and support do instructors with each style tend to use? Techniques to facilitate student collaboration will be emphasized. Students from each class will be asked to complete a questionnaire on their perceptions of the instructional approaches used during their course that will be compared to the intended treatment. Student preferences for e-learning and sense of learner-centeredness will be compared to the instructional approach of that class. A follow-up or alternative experiment would expand the teaching metaphors to 20-30 options as well as the number of instructors involved and have them select the ones that best describe their online teaching. Such a survey could determine not only the type of instructional approach best suited to e-learning, but also ferret out any differences in the instructor role in simple and more complex e-learning courses. An additional study might entail using such a survey over a number of weeks or months to note any changes in instructor perceptions of their role over time. The relationship between student performance and learning outcome will be examined.

Initial experiment: Instructional approach preferences.

Independent Variable: Online teaching approach (5)	Dependent variable: Student preferences
1. Teacher as guide 2. Teacher as host, or friend 3. Teacher as provocateur 4. Teacher as instructor 5. Combination	• Preference for e-learning • Sense of learner-centeredness

Follow up survey: Determine best approach for e-learning (depending on the complexity of the course).

- Present 20-30 teaching metaphors (i.e., teacher as a coach, expedition leader, etc.)
- Have instructors select the metaphors that best describe their online teaching approach.
- Look for differences in the role of the instructor for complex and simple courses.

Experiment III. Student Perceptions of E-Learning Environment

In the training literature, student perception of the overall learning environment has been an uncertain predictor of student achievement whereas student perception of interactivity corresponds to learning achievement (Payne, 1999). There is a more direct relationship between overall perception and achievement in educational settings. The issues in this experiment are: Do students perceive the Web as an individual learning tool, a competitive learning environment, or a place for collaboration? When students view a collaborative tool as useful only for completing their individual work, then it is problematic. If the intended tool does not match perceived utility on the part of the learner, then hypotheses in many distance education environments will be faulty. In this experiment, the variable of interest is student perceptions of their learning environment. A survey instrument will be created that explores whether students in an online training environment embedded with extensive collaborative tools perceive an emphasis on individual, competitive, or collaborative learning. In addition, interviews with students will

determine the types of activities that are truly collaborative and the associated tool features that enhance feelings of collaboration. Electronic transcripts of tasks performed online will be coded for collaborative, competitive, and individual learning acts. The transcripts will also be utilized in student interviews during retrospective analyses of learning. Students' perceptions of the actual type of learning environment will be compared with completed surveys of preferred learning environments. Student perceptions of their learning environment will be correlated with their actual performance, thereby providing one indicator of the type of e-learning environment that might foster student learning. Comparisons of student perceptions in procedural and more complex learning environments (e.g., officer training) will indicate whether different types of courses force different pedagogical approaches.

Initial study: Correlate student perceptions of their learning environment with their performance.

Independent variable (predictor): Student's perception of emphasis of online training (3).	Dependent variable (criterion): Performance
1. Individual learning 2. Competitive learning 3. Collaborative learning	• Actual course performance

Follow up study:

- Interview students to determine the types of activities and associated tools they consider collaborative.
- Code electronic transcripts of online tasks for collaborative, competitive and individual acts.
- Use transcripts for future interviews and analysis of student learning.

Compare student perceptions across task complexity to determine if different courses force different pedagogical approaches.

Experiment IV. The Development of Online Learning Communities

Interaction is central to learning. Tools to foster student social interaction and collaboration are proliferating in distance education environments. As a result, many researchers are focusing on the development of online learning communities. Military recruits taking a series of e-learning courses are involved in many new types of learning communities. How do they react to the different types of courses? How are electronic communities formed? What are the key components? What factors help with student retention in those courses? And what are some early indicators of successful online learning communities? In this study, the *Social Constructivism and Learning Communities Scale Online* (SCALCO) student survey will be developed and tested (see Table 12, Appendix A). The SCALCO will explore the degree of social interaction and constructivism fostered by online collaborative tools as well as the factors leading to successful online communities. It will be administered to students at the start and end of 10-15 online courses. The results from a content analysis of the tools and activities embedded in these courses will be compared to student answers. Interaction analyses of electronic transcripts will determine the degree of interactivity and responsiveness in online collaboration. An instructor version of the SCALCO will also be created in order to compare student and instructor perceptions of online learning environments. Researchers will interview at least six students and four instructors to determine components leading to online communities.

Study Purpose: Use SCALCO to explore the degree of social interaction and collaboration fostered by online collaborative tools, and the factors leading to successful online communities.

Pre Post test design
• Administer SCALCO • Expose subject to 10-15 online courses • Administer SCALCO • Content analysis of the tools and activities embedded in these courses • Compare content to student answers • Interaction analysis of electronic transcripts (determine the degree of interaction and responsiveness)

Follow up:

- Develop instructor version of SCALCO
- Administer SCALCO to instructors
- Compare student and instructor perceptions of online learning environments
- Interview at least six students and four instructors to determine components leading to online communities

Experiment V. Time Logging: Effect of E-Learning Approach on Time

Most instructors and students find that e-learning courses are highly time intensive compared to traditional instruction. Thus, time is a key factor in the success of e-learning. In this study, four instructors will log their time spent interacting in an online course over a three-month period. After a brief training program, each instructor will assume a different pedagogical strategy: (1) guide or facilitator of student learning (i.e., using indirect or Socratic teaching methods); (2) lecturer or expert mentor (i.e., direct instructional approaches); (3) co-participator or co-learner (i.e., learning and discovering as a fellow students); or (4) host or hostess (i.e., coordinating events, managing activities, and helping students meet each other). Time spent by the instructor will be compared to the particular form of teaching employed. The hypothesis here is that the instructional approach will significantly impact on the amount of instructor time. Students in these classes also will be asked monthly to record their time, both in total number of hours per day or week as well as timing. Student performance will be compared to whether they adopted a massed or distributed practice approach for completing activities and studying for exams. Their time logs will also be compared to the instructional format for indicators of the instructional approach that fostered greater student participation and engagement. The key hypothesis here is that when instructors assume a lecturer role (Condition #2), student online participation decreases.

Experiment: Instructor will log time spent on course over a three-month period.

Independent variable: Pedagogical strategy (4)	Dependent variable: Time spent
1. Guide or facilitator (indirect) 2. Lecturer or expert mentor (direct) 3. Co-participator or co-learner 4. Host or coordinator	• As recorded in instructor's log

Hypothesis:

1. Instructor approach will be significantly related to the amount of time spent by the instructor.

Follow up:

- Students will log time spent (monthly).
- Students will indicate whether they used massed or distributive practices when completing tasks and studying (IV).
- Compare practice style to performance (DV).
- Compare student time logs to type of instructional approach.

Hypothesis:

1. Lecture approach (Condition 2) will decrease student online participation.

Experiment VI. Critical Thinking and Problem Solving Applications in Synchronous and Asynchronous Environments

The development of critical thinking and problem solving skills is central to learning. Garrison (1991) mapped out five key stages of adult critical thinking and problem-solving that are often used to analyze the effectiveness of e-learning environments. But do online environments really impact student problem solving abilities? Using Newman, Johnson, Cochrane, and Webb's (1996) model for exploring critical thinking in online discourse, students in one military training course will be divided into four collaborative groups (see Table 7). The first group will utilize synchronous chat tools to generate problem statements and ideas for solution, followed by asynchronous tools for idea evaluation and integration. The second group will engage in the reverse situation of Group 1—asynchronous generation of ideas followed by synchronous evaluation, ranking, and integration. Group 3 will utilize synchronous tools for both problem generation and evaluation. Finally, the last group will use only asynchronous tools. Student attitudes about each environment will be collected and compared. Questions to be asked include: What is the level of involvement across different group members during different phases of a task? What tools will foster greater learning and interaction at different problem solving stages? How successful is networking in terms of facilitating appropriate levels of interaction among the participants? What phases or steps are involved in the definition and completion of shared tasks? Transcripts will be coded using Newman et al.'s scheme and compared for the types of critical thinking embedded in the dialogue (e.g., justification, idea linking, critical assessment, relevancy, importance, etc.). In addition, the *Constructivist Interaction Analysis Coding Scheme* of Kanuka and Anderson (1998; see Table 8, Appendix A) will be utilized to determine the phase of social construction of knowledge that each group obtained. Next, the online dialogue will be coded for the type of utterances in online collaboration (Curtis & Lawson, 1999, see Table 9). To what degree were students in each condition planning, contributing, seeking input, reflecting or monitoring on their work, and socially interacting? What help giving behaviors positively impact on performance? Participation will be coded for surface or in-depth commenting to determine which forum fosters more integrative and deep thinking (see Table 6). Finally, changes in interaction patterns will be mapped out over time. A key hypothesis here is that Group 2 (synchronous followed by asynchronous tools) will be the most productive in terms of number of ideas generated and evaluated. This group will exhibit higher levels of social construction of knowledge than the other groups since the real-time chat will allow group members to learn about each other and generate many ideas while the follow-up delayed discussions will promote negotiation of those ideas.

Experiment: Effect of e-learning tools on learning and interaction.

Independent variable: Course characteristics (4)	Dependent variable: Student attitudes and perfomance
1. Synchronous generation of ideas, asynchronous evaluation 2. Asynchronous generation of ideas, synchronous evaluation 3. Synchronous tools for both generation of ideas and evaluation 4. Asynchronous tools for both generation of ideas and evaluation	• Level of involvement across group members and tasks • Which tool characteristics will foster the greatest learning and interaction? • Number of ideas generated? • Number of ideas evaluated?

Follow up:

- Code transcripts using Newman et al.'s (1996) model for exploring critical thinking in online discourse (e.g., justification, idea thinking, critical assessment, etc.).
- Use the Constructivist Interaction Analysis Coding Scheme of Kanuka and Anderson (1998) to determine the phase of social construction of knowledge for each group.
- Code online dialogue for collaboration utterances (Curtis and Lawson,1999)
- Code participation for surface or in-depth commenting.
- Map changes in interactions over time.

Hypotheses:

1. Group 2 (synchronous generation, asynchronous evaluation) will be most productive in number of terms generated and evaluated.
2. Group 2 will also exhibit higher levels of social construction of knowledge than the other groups.

Theory:

Real-time chat will allow group members to learn about each other and generate many ideas, while latter delayed discussion will promote negotiation of those ideas.

Experiment VII. Peer Tutoring and Online Mentoring: Impact of Peer Tutoring on E-Learning Achievement

This study looks at the impact of peer tutoring on student e-learning achievement. What is effective timing, quantity or extent, type, etc. of online mentoring? Students in the e-learning course will be randomly assigned to one of six conditions: (1) mentoring by former students who successfully completed the course online; (2) mentoring by former students who took the course in a live setting; (3) mentoring by guest experts; (4) mentoring by peers in the current course; (5) mentoring from a combination of peers, guests, and experts; and (6) a no mentoring control condition. All mentors will receive some brief online training about forms of online mentoring (see Table 11). They will then be available to the students via electronic mail for questions, advice, and general support. Student performance in each environment will be compared. Student preferences for these different mentoring environments will be addressed with both a questionnaire and interviews of randomly selected students. Transcripts will be coded for the types of online mentoring and scaffolding in each of these environments. In addition, this analysis will note the timing and degree of online support that was provided. A comparison of the effectiveness of the five mentoring conditions will look at the level and timing of support as well as overall mentor responsiveness. Two of the mentors in each condition will also be

interviewed via the telephone or an online chat. At the end of this study, an online mentoring guide will be developed to help in the selection and training of mentors. A key hypothesis here is that the combined mentoring approach and mentoring by students who took the course in an online format will result in higher levels of student performance. Second, students in any of the five mentoring conditions will outperform those in the control condition.

Experiment: What type of scheduling, approach, quantity, etc. of online mentoring is most effective?

Independent variable: Mentoring condition (6)	Dependent variable: Student performance
1. Mentoring by former students who have successfully completed the course online 2. Mentoring by former student who have taken the course in a live setting 3. Mentoring by guest experts 4. Mentoring by peers in the current course 5. Mentoring by a combination of peers and experts 6. Control, no mentoring	• Compare student performance between groups

*Note: All mentors receive some training on online mentoring, and use e-mail to communicate with students.

Follow up:

- Questionnaires and interview of randomly selected students will be used to assess student preference for different conditions (1-6).
- Transcripts will be coded to include: Type of mentoring and scaffolding, and timing and degree of online support provided.
- Two of the mentors from each condition will be interviewed.
- An online mentoring guide will be developed to help the selection of future mentors.

Hypotheses:

1. The combined mentoring approach and mentoring by students who took the course online will yield the highest student performers.
2. Students in all of the five mentoring conditions will outperform the control group.

Experiment VIII. Student Retention: E-Learning and Attrition

Though relying mainly on anecdotal data, it seems that a major problem of e-learning environments is the retention of students. What factors help new recruits complete a degree program? What e-learning formats and approaches stimulate greater motivation? What pedagogical factors facilitate retention? For instance, does a more flexible format increase retention? In this experiment, there are four learning formats available:

1. instructor minimal presence, extensive student choice—in this condition, students decide on all assignments from a menu of possibilities provided by the instructor;
2. instructor dictated, minimal choice—here, the instructor is clear about all assignments and provides explicit task structuring;
3. instructor guidance, some choice—here the instructor acts as a guide or facilitator of student online learning while students have some input in class activities; and

4. instructor varied roles in an online community—the emphasis in the fourth condition is on building collaborative teams and constructing knowledge in groups; hence, the role of the instructor is constantly changing.

Student attitudes and attrition rates will be compared across the four conditions. Computer logging data will note student participation over time. Access to technology, previous computer experience, and self-efficacy will be correlated with course attrition. Transcripts, interviews, and retrospective analyses will determine what communication patterns or instructional techniques are beneficial to students whose interaction wanes during different time periods of the course. Interviews and course content analyses with the instructors will determine the more and less successful strategies here. Upon completion of the course, student intentions to enroll in other e-learning situations will be compared. It is hypothesized that the first two conditions will result in the highest dropout rates.

Experiment: What are the pedagogical factors that foster retention of online students?

Independent variable: Learning format (4)	Dependent Variable: Course attrition
1. Teacher minimal presence, extensive student choice of assignments from a menu 2. Teacher dictated, minimal student choice 3. Teacher guidance, some student choice 4. Teacher varied roles in an online community, teacher role is dynamic	• Attrition rates • Attrition categories • Student attitudes

Follow up:

- Access to technology, computer experience and self-efficacy will be correlated with attrition.
- Student intentions to enroll in future e-learning situation will be investigated.

Hypothesis:

1. Condition 1 and 2 will result in the highest drop-out rate.

Experiment IX. Conceptual Referencing: Collaboration and Explicit Referencing

How do different collaborative tools foster student learning of key concepts? Can tools help students explicitly reference course ideas, concepts, and issues as well as the ideas of their peers? Will student explicit conceptual and peer referencing in online environments foster greater learning and interaction than in traditional classroom settings? In this research project, students will study a set of tactical principles and then practice them in a simulated gaming environment. After the simulation, one group will discuss the tactics in small groups of 4-6 participants using a computer conferencing tool. Here students will be forced to label their posts as hypotheses, evidence, data, critical issues, personal opinions, etc. They will also be required to refer to at least one previous post in each of their messages. The other group will provide the instructor with individual reflection summaries of the activity via email. The depth of student reflections in each environment will be compared. The following week, another set of similar maneuvers will be discussed in a synchronous chat. The ideas of students in each group will be compared. Student attitudes toward each environment will be compared. It is hypothesized that students in the small group condition will outperform the individual reflection condition during the synchronous chats.

Experiment: Two groups of students will study five key military maneuvers and practice them in a simulated environment.

Independent variable: Group membership (2)	Dependent variable: Performance during chat
1. Small group (4-6) using a computer conferencing tool such as, ACT to discuss tactics 2. Individual providing reflective summaries to an instructor via email	• Depth of reflections • Strength of ideas

Follow up:

- One week later a set of similar maneuvers will be discussed in a synchronous chat.

Hypothesis:

1. Students in the small group condition will outperform the individual reflection condition during the synchronous chats.

Experiment X. Online Collaboration: Group Performance and Collaborative Learning Technologies

As collaborative tools are developed, it is vital to understand how groups function and perform online. How do members share different views of data and instrument controls? How do text pointing and document sharing devices impact on collaboration? What cutting edge collaborative learning technologies might foster student-centered learning? How aware are students and instructors of the various tools for collaboration? For this study, the Army will acquire a set of ten or more different collaborative tools for e-learning. Once acquired, 50 individuals will be taken to a computer lab wherein they will receive demonstration on different types of collaborative tools and activities (e.g., conferencing tools, videoconferencing, email, collaborative writing and notetaking tools, peer writing document annotation tools, chat tools, group decision support systems, voting and polling tools, electronic brainstorming, etc.). They will then meet together as a focus group to discuss the benefits and limitations of some of these tools. They will then rate these tools for the degree of collaboration, ease of use, degree of interaction, and potential for online course adaptability. In a follow-up experiment, a second focus group of 5-6 collaborative learning experts will evaluate these features and make suggestions for improvement. Here, a nominal group process will be used to gather initial opinions and rankings. In the third leg of this study, student and instructor preferences will be compared to their learning style inventories. Student and expert collaborative tool preferences also will be compared.

Initial study: Have students compare collaborative tools for e-learning.

Focus group: Discuss benefits and limitations of 20-30 different tools	Rating the tools
Examples of tools: • Videoconferencing • Email • Collaborative writing and note taking • Chat • Group decision support systems • Voting	Rating dimensions: • Degree of collaboration • Ease of use • Degree of interaction • Potential for online course adaptability

Follow up:

- Focus group of 5-6 collaborative learning experts.
- Give opinions, evaluate features and make suggestions.
- Compare student and expert tool preferences to their learning style inventories.
- Compare student and expert collaborative tool preferences.

Suggested Secondary Experiments

Of course, there are many other possible experiments. Seventeen additional experiments are briefly described in Appendix C. The purpose is to illustrate the wealth of opportunities for the Army to capitalize on concepts, experiments, and findings from the educational literature. Many more could have been designed.

New Tools and Pedagogies

As we look to the future, it is clear that e-learning pedagogy and research is just beginning to be defined and understood. There are emerging opportunities for encouraging cross-classroom collaboration, guiding online mentoring and apprenticeship, facilitating telepresence events and activities, offering professional development, using archived information databases, and asking questions of online human information sources (Riel & Harasim, 1994). Teamwork on projects with real audiences or clients across the globe is now a common way to engage students in the learning process (Bonk & Sugar, 1998; Kearsley & Shneiderman, 1998; Riel, 1990).

However, tools for fostering such team projects and interactions are crude or nonexistent in most higher education and training courseware today (Bonk & Dennen, 1999). Clearly, there is a need to develop collaborative tools such as domain specific whiteboards that help create, edit, and display drawings, graphs, and models. In addition, annotation and sharing tools with advanced visualizations and modeling tools should populate the e-learning workspace of the near future (Roschelle & Pea, 1999). Some of these tools and computer systems will prestructure the learning contributions and interactions, while others will allow more open-ended inquiry. Tools already exist to support multiple viewpoints, reflection, frequent feedback, knowledge construction and notetaking, shared representations, and progressive expert questioning (Roschelle & Pea, 1999). A myriad of technologies are available to match different tasks and individual needs. For example, student collaboration can be fostered via videoconferencing, computer conferencing, e-mail, document sharing, and document authoring (Holland, 1996).

In light of these technological developments, it is vital to reflect on how to develop online interactions with these tools and how to foster social negotiation of meaning (Bonk, 1998; Hughes & Hewson, 1998; Parker, 1999). Instructors not only have to think carefully about the activity structures and instructional events that they want to include, but they now must evaluate available technologies for each new structure or pedagogical strategy that they dream up. As technologies for interaction advance at rates unimaginable a mere decade or even a few months ago, there is a need to test pedagogical inventions that can foster online collaboration and problem solving such as case studies, jigsaw, brainstorming, role plays, simulations, symposiums, delphi techniques, transcript based assignments, forums, nominal group techniques,

projects, panels, etc. (Bonk & Dennen, 1999; McLoughlin & Oliver, 1999; Paulsen, 1995b). How might e-learning courses be enhanced, extended, or transformed with global interpersonal exchanges, electronic guest experts, collaborative databases, information exchanges, electronic publication of student work, extensive peer feedback, or online simulations (Harris, 1998)? When will such pedagogical experiments and successes be shared and discussed? And who will foster this sharing of online course information?

The issues and questions raised above will only accelerate in the near future. Already, McKenzie, Kirby, Newbill, and Davidson (1998, p. 123) contend, "As the world grows smaller the need for more educational opportunities for more people in more places will become epidemic. Effective distance educational programs led by effective instructional design specialists will have to one of the cures." As that happens, education and training in the US military will be increasingly defined as collaborative and learner-centered in nature. Research and experimentation on emerging tools and pedagogies will be more vital than ever before. As a result, the research performed by the Army on collaborative and e-learning tools from a student-centered learning perspective today will play a significant role in improving learning gains tomorrow.

As the Army transforms from a classroom-centric to a soldier-centric model of instruction, planners, training developers, and researchers must maintain cognizance of the 14 learner-centered psychological principles outlined in Table 1. For the full benefits of the new e-learning and collaborative tools emerging from the educational marketplace, conformance to these principles and planned adaptation to a military training environment are key factors for success. Hopefully, the sources provided in this report and the experiments outlined will provide a complementary impetus to the transformation.

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APPENDIX A

Supplemental Tables

Appendix A
Table 1
Learner-Centered Psychological Principles Revised

Cognitive and Metacognitive Factors

1. **Nature of the learning process.** The learning of complex subject matter is most effective when it is an intentional process of constructing meaning from information and experience.
2. **Goals of the learning process.** The successful learner, over time and with support and instructional guidance, can create meaningful, coherent representations of knowledge.
3. **Construction of knowledge.** The successful learner can link new information with existing knowledge in meaningful ways.
4. **Strategic thinking.** The successful learner can create and use a repertoire of thinking and reasoning strategies to achieve complex learning goals.
5. **Thinking about thinking.** Higher order strategies for selecting and monitoring mental operations facilitate creative and critical thinking.
6. **Context of learning.** Learning is influenced by environmental factors, including culture, technology, and instructional practices.

Motivational and Affective Factors

7. **Motivational and emotional influences on learning.** What and how much is learned is influenced by the learner's motivation. Motivation to learn, in turn, is influenced by the individual's emotional states.
8. **Intrinsic motivation to learn.** The learner's creativity, higher order thinking, and natural curiosity all contribute to motivation to learn. Intrinsic motivation is stimulated by tasks of optimal novelty and difficulty, relevant to personal interests, and providing for personal choice and control.
9. **Effects of motivation on effort.** Acquisition of complex knowledge and skills requires extended learner effort and guided practice. Without the learner's motivation to learn, the willingness to exert this effort is unlikely without coercion.

Developmental and Social Factors

10. **Developmental influences on learning.** As individuals develop, there are different opportunities and constrains for learning. Learning is most effective when differential development within and across physical, intellectual, emotional, and social domains is taken into account.
11. **Social influences on learning.** Learning is influenced by social interactions, interpersonal relations, and communication with others.

Individual Differences

12. **Individual differences in learning.** Learners have different strategies, approaches, and capabilities for learning that are a function of prior experience and heredity.
13. **Learning and diversity.** Learning is most effective when differences in learners' linguistic, cultural, and social backgrounds are taken into account.
14. **Standards and assessment.** Setting appropriately high and challenging standards and assessing the learner as well as learning progress—including diagnostic, process, and outcome assessment—are integral parts of the learning process.

Table 7

Indicators of critical thinking for online discourse
(from Newman, Johnson, Cochrane, & Webb,1996)

R+/- Relevancy	R+ Relevant Statements	R- Irrelevant statements, diversions
I+/- Importance	I+ Important points/issues	I- Unimportant, trivial points/issues
N+/- Novelty, new info, ideas, solutions	N+ New problem-related information	N- Repeating what has been said
	N+ New ideas for discussion	N- False or trivial leads
	NS+ Accepting first offered solution	NS- Accepting first offered solution
	NQ+ Welcoming new ideas	NQ- Squashing, putting down new ideas
	NL+ Learner (student) brings new things in	NL- Dragged in by tutor
O+/- Bringing outside knowledge/experience to bear on problem	OE+ Drawing on personal experience	
	OC+ Refers to course material	
	OM+ Use relevant outside material	
	OK+ Evidence of using previous knowledge	
	OP+ Course related problems brought in; e.g., students identify problems from lectures and texts	
	OQ+ Welcoming outside knowledge	OQ- Squashing attempts to bring in outside knowledge
		O- Sticking to prejudice or assumptions
A+/- Ambiguities; clarified or confused	AC+ Clear, unambiguous statements	AC- Confused statements
	A+ Discuss ambiguities to clear them up	A- Continue to ignore ambiguities
L+/- Linking ideas, interpretation	L+ Generating new data from information collected	L- Repeating information without making inferences or offering an interpretation
	L+ Linking facts, ideas, and notions	L- Stating that one shares the ideas or opinions stated, without taking these further or adding any personal comments
J+/- Justification	JP+ Providing proof or examples	JP- Irrelevant or obscuring questions or examples
	JS+ Justifying solutions or judgments	JS- Offering judgments or solutions without explanations or justification
	JS+ Setting out advantages and disadvantages of situations or solution	JS- Offering several solutions without suggesting which is the most appropriate
C+/- Critical assessment	C+ Critical assessment/evaluation of own or others contributions	C- Uncritical acceptance or unreasoned rejection
	CT+ Tutor prompts for critical evaluation	CT- Tutor uncritically accepts
P+/-Practical utility (grounding)	P+ Relate possible solutions to familiar situations	P- Discuss on a vacuum (treat as if on Mars)
	P+ Discuss practical utility of new ideas	P- Suggest impractical solutions
W+/- Width of understanding (complete picture)	W+ Widen discussion; e.g., problem within a larger perspective, intervention strategies within a wider framework	W- Narrow discussion; e.g., address bits or fragments or situation, suggest glib, partial, interventions

Table 8

Constructivist Interaction Analysis Coding Scheme
(Kanuka & Anderson, 1998)

Phase I: Sharing/Comparing of Information
a. A statement of observation or opinion
b. A statement of agreement from one or more other participants
c. Corroborating examples provided by one or more participants
d. Asking and answering questions to clarify details of statements
e. Definition, description or identification of a problem
Phase II: Discovery of dissonance and inconsistency
a. Identifying and stating areas of disagreement
b. Asking and answering questions to clarify disagreement
c. Restating and possibly advancing arguments in its support
Phase III. Negotiation of Meaning/Co-construction of knowledge
a. Negotiation or clarification of meaning of terms
b. Negotiation of weight assigned to types of argument
c. Negotiation of agreement among conflicting concepts
d. Negotiation of compromise or co-constructions
e. Proposal of integrating/accommodating metaphors or analogies
Phase IV. Testing and modification of proposed synthesis
a. Testing that proposal synthesis
b. Testing against existing cognitive schema
c. Testing from personal experience
d. Testing against informal data collected
e. Testing against contradictory testimony in the literature
Phase V. Agreement/application of newly constructed meaning
a. Summarization of agreement
b. Illustrations of the new knowledge as applied to work
c. Metacognitive statements by the participants illustrating change

Table 9

Coding scheme to describe utterances in online collaboration (Curtis & Lawson, 1999)

Behavior Categories	Codes	Description	Example
Planning	GS	Group skills; a generic code applied to expressions that encourage group activity and cohesiveness	I know that [names] have given you good advice, but I think it's worth knowing that you need patience.
	OW	Organizing work: Planning group work; setting shared tasks and deadlines.	I just want to set a time-line for myself. Is everyone OK with that?
	IA	Initiating activities: Setting up activities such as chat sessions to discuss the progress and organization of group work.	I would like to chat on the blackboard. What about this Friday at 7:30 pm SA time?
Contributing	HeG	Help giving: Responding to questions and requests from others.	To access the chat room, click on virtual chat in the blackboard; chat screen will come on; click on enter...
	FBG	Feedback giving: Providing feedback on proposals from others.	I like your idea of a generic booklet and everyone contributing aspects of interesting internet services...
	RI	Exchanging resources and information to assist other group members	With the implementation of an internet service...there has been a major shift in the communication function in business.
	SK	Sharing knowledge: Sharing existing knowledge and information with others.	I think we also need to give thought to the following: 1. The issues of quality/efficiency in teaching and learning...
	CH	Challenging others: Challenging the contributions of other members and seeking to engage in debate.	No examples—behavior not identified in the text.
	EX	Explaining or elaborating: Supporting one's own position (possibly following a challenge).	No examples—behavior not identified in the text.
Seeking Input	HeS	Help seeking: Seeking assistance from others.	Does anyone know how to edit/add/append data on the student pages?
	FBS	Feedback seeking: Seeking feedback to a position advanced.	What do you think about answering the questions that...have been put forward?
	Ef	Advocating effort: Urging others to contribute to the group effort.	Haven't heard from you for awhile. Are you still with us?
Reflection/ Monitoring	ME	Monitoring group effort: Comments about the group's processes and achievements.	I believe the overall contribution and collaboration of working as a group requires an increase within itself as part of our learning.
	RM	Reflecting on medium: Comments about the effectiveness of the medium in supporting group activities.	The email for the discussion group seems to work OK for me. You know it has gone through because you actually receive your email back almost straight away if it has worked.
Social Interaction	SI	Social interaction: Conversation about social matters that are unrelated to the group task. This activity helped to 'break the ice.'	Regarding chat—my weekend is pretty hectic—I have my family flying in from Greece...so the Greek festivities will be in full swing.

Table 11

Twelve forms of electronic learning mentoring and assistance (Bonk & Kim, 1998; Tharp, 1993)

1.	Social (and cognitive) Acknowledgement: "Hello...," "I agree with everything said so far...," "Wow, what a case," "This case certainly has provoked a lot of discussion...," "Glad you could join us..."
2.	Questioning: "What is the name of this concept...?," "Another reason for this might be...?," "An example of this is...," "In contrast to this might be...,""What else might be important here...?," "Who can tell me....?," "How might the teacher..?." "What is the real problem here...?," "How is this related to...?," "Can you justify this???"
3.	Direct Instruction: "I think in class we mentioned that...," "Doesn't Chapter "X" talk about...," "Remember back to the first week of the semester when we went over "X" which indicated that..."
4.	Modeling/Examples: "I think I solved this sort of problem once when I...," "Remember that video we saw on "X" wherein "Y" decided to...," "Doesn't "X" give insight into this problem in case "#..." when he/she said..."
5.	Feedback/Praise: "Wow, I'm impressed...," "That shows real insight into...," "Are you sure you have considered...," "Thanks for responding to "X"...," "I have yet to see you or anyone mention..."
6.	Cognitive Task Structuring: "You know, the task asks you to do...," "Ok, now summarize the peer responses you have received...," "How might Slavin or Woolfolk have solved this case"
7.	Cognitive Elaborations/Explanations: "Provide more information here that explains your rationale," "Please clarify what you mean by..." "I'm just not sure what you mean by...," "Please evaluate this solution a little more carefully."
8.	Push to Explore: "You might want to write to Dr. "XYZ" for...," "You might want to do an ERIC search on this topic...," "Perhaps there is a URL on the Web that addresses this topic..."
9.	Fostering Reflection/Self Awareness: "Restate again what the teacher did here...," "How have you seen this before...," "When you took over this class, what was the first thing you did...," "Describe how your teaching philosophy will vary from this...," "How might an expert teacher handle this situation..."
10.	Encouraging Articulation/Dialogue Prompting: "What was the problem solving process the teacher faced here...," "Does anyone have a counterpoint or alternative to this situation...," "Can someone give me 3 good reasons why...," "It still seems like something is missing here, I just can't put my finger on it..."
11.	General Advice/Scaffolding/Suggestions: "If I were in her shoes, I would...," "Perhaps I would think twice about putting these kids...," "I know that I would first...," "How totally ridiculous this all is; certainly the teacher should be able to provide some..."
12.	Private E-mail or Discussion Management: "Don't just criticize....please be sincere when you respond to your peers," "If you had put your case in on time, you would have gotten more feedback." "If you do this again, we will have to take away your privileges."

Table 12

Social Constructivism and Learning Communities Online (SCALCO) Scale (Bonk, Malikowski, Angeli, & East, 1998; Bonk, Oyer, & Medury, 1995; Kanuka & Anderson, 1998)

Part A. Social Constructivism and Learning Communities Online Questionnaire Questions (1 = strongly agree; 5 = strongly disagree)
1. The topics discussed online had real world relevance.
2. The online dialogue dealt with original topics.
3. As the forum progressed, I developed a position on various topics that I did not have before the online forum.
4. The online forum dialogue offered multiple perspectives.
5. The online dialogue encouraged me to reflect on the issues.
6. I integrated new knowledge acquired from the online discussion into my existing knowledge, which resulted in a deeper understanding of the issues.
7. I made new connections to the course material as a result of the online environment.
8. I have more ideas that I can use about this topic than without the online forum.
9. The online forum nurtured my critical thinking and evaluation skills.
10. I had a voice within the discussion forum.
11. I had some personal control over course activities and discussion.
12. Online discussions were <u>not</u> relevant to my learning needs.
13. The online technology allowed me to design and create new ideas.
14. The online environment encouraged me to question ideas and perspectives.
15. I liked collaborating with others online.
16. Instructors provided useful advice and guidance online.
17. I could count on others to reply to my needs.
18. The online environment fosters an atmosphere where more than one answer may be correct.
19. I collaborated with other participants in the forum that resulted in new perspectives and a better understanding.
20. I felt that I was a member of the group.
21. The other group participants acknowledged my contribution to the discussion.
22. I felt committed with other online participants to work together in order to acquire a deeper understanding of the issues.
23. I felt the discussion took the issues to a deeper level.
24. The online forum provided opportunities for in-depth discussion.
25. I clarified my ideas by sharing them with others online.
26. I clarified my ideas by reading other participants' comments.
27. I gained an appreciation for other opinions and perspectives.
28. I received useful mentoring and feedback from others.
29. The online environment fostered peer interaction and dialogue about real-life problems.
30. The online discussions lowered the isolation and loneliness of similar learning situations.
31. The online forum fostered a sense of a collaborative learning community.
32. There was a sense of membership in a learning here.
33. Other participants and I make decisions about how we will proceed or learn online.
34. Instructors or moderators provide just enough resources to help me succeed online.
35. This environment had opportunities to prepare answers with peers or learning teams.
36. Peer evaluation and feedback was integrated into this learning environment.
37. The online environment allowed for the exploration of topics of personal interest.
38. I could share and discuss my ideas and answers with others in this environment.
39. It was interesting to see how differences of opinion were discussed and negotiated in this environment.
40. Summaries or compromise positions were facilitated in this environment.

Appendix B
List of URLs (Universal Resource Locators) cited in text

Page 5
U.S. Army Research Institute for the Behavioral and Social Sciences FY200 program (http://www.ari.army.mil)

Page 8
Learner-Centered Psychological Principles Revised (http://www.apa.or/ed/lcp.html)

Page 10
Carr, 2000a, February 11th (http://chronicle.com/free/v46/i23/23a00101.htm)

Page 13
Peffers & Bloom, 1999 (http://clam.rutgers.edu/~ejournal/spring99/survey.htm)

Paulsen, 1995a (http://www.emoderators.com/moderators/morten.html)

Page 17
Bannon & Hughes,1993 (http://www.ul.ie/~idc/library/papersreports/LiamBannon/1/BannonHughes.html)

CSCL Conference 1995 (http://www-csc195.indiana.edu/csc195)

Page 18
Lau & Hayward, 1997 (http://search.ahfmr.ab.ca/tech_eval/gss.htm)

Page 23
Paulsen, 1995b (http://www.hs.nki.no/~morten/cmcped.htm)

Page 24
Herring, 1999 (http://www.ascusc.org/jcmc/vol4/issue4/herring.html)

Page 31
TAPPED IN (http://www.tappedin.sri.com)

Page 34
Russell, 1999 (http://cuda.teleeducation.nb.ca/nosignificantdifference/)

Page 35
WebTrends Log Analyzer software (http://www.webtrends.com)

Carr, 2000b, February 14th (http://chronicle.com/free/2000/02/200021401u.htm)

Page 37
College syllabi posted at the World Lecture Hall (http://www.utexas.edu/world/lecture/)

Appendix C
Secondary Experiments

1. Testing and comparison of the effectiveness of various instructional approaches (i.e., debates, role play, synchronous chatting, online forums, online symposia, simulations, etc.) (Doherty, 1998). Which of these pedagogical activities are more likely to stimulate student motivation and satisfaction and knowledge acquisition? (Bracewell, Breuleux, Laferriere, Benoit, & Abdous, 1998).
Independent variables: Demographics, two or more instructional approaches, two or more learning categories, frequency of use (e.g., daily, weekly, monthly)
Dependent variables: Performance on post-test, level of satisfaction, ease of use
Application area: Captains Career Course, Professional Development, Reserve Component functional training

2. Does participation in e-learning increase writing skills, problem solving skills, and knowledge retention? (Riel & Harasim, 1984).
Independent variables: Instructional approach: conventional vs. DL, a writing sample, demographics
Dependent variables: Performance on multiple post-tests, writing sample, metacognitive skills demonstrated in a problem solving task.
Application area: Service Academies; Professional Development

3. What is the balance between presentational and constructivist pedagogical strategies for different types of problem solving or e-learning? (Dede, 1996b)
Independent variables: 2 or more instructional approaches, 2 pedagogical strategies, demographics
Dependent variables: Metacognitive strategies used, problem solving task
Application area: Digital skill training; Battle Staff

4. What types of learning assistance and support do peers and expert mentors provide in Web-based conferences? (Bonk, Malikowski, Angeli, & East, 1998; Bonk, Malikowski, Angeli, & Supplee, 1998; See Table 11)
Independent variables: 2+ types of conference formats, support personnel (peer and expert), demographics
Dependent variables: Feedback and self report: Was assistance adequate? Which support person helped you the most? Availability of support?
Application area: Development of operation order; Web conferencing

5. How might student learning styles be utilized and perhaps mixed in online collaborative teams to maximize interaction and performance?
Independent variables: Learning strategies (homogeneous and heterogeneous groups), demographics
Dependent variables: Post-test measure of performance, attitudinal measure, productivity, multiple post-tests
Application area: Throughout Army Distance Learning; Refresher training

6. Comparison of computer adaptive testing with different levels of hints or scaffolds available to the learners on demand (i.e., from general to specific).
Independent variables: Demographics, 3 groups: 1) with all hints, 2) with solicited hints only, 3) with guided hints (artificial intelligence or hints for different levels of needs), specificity of hints (general, detailed)
Dependent variables: Performance, attitudes/satisfaction, learning styles
Application area: Refresher training; Individual Ready Reserve

7. Who decides when a skill is needed as well as who should provide the training? Some insight might come from a study of learner search strategies and navigation when helping solve a team project? What increases search effectiveness, depth, and satisfaction? How do other team members encourage exploration?
Independent variables: Demographics, computer/Internet experience, previous use of search engines, measure of open-mindedness, computer anxiety, self-efficacy
Dependent variables: Group work survey, resourcefulness (# of hits), performance on selected search tasks (e.g., time, efficiency, comprehension, problem solving)
Application area: University After Next; Operational USCRS (S-3)

8. Comparison of student attitudes and experiences when they know their work has real or authentic audiences and will be archived for future learners (i.e., permanent) versus those in environments wherein their audience is simply the teacher (impermanent text).
Independent variables: Demographics, experience level with subject matter, 2 groups (permanent vs. impermanent text), goal orientation—task completion or learning or mastery
Dependent variables: Attitudes, Post-test measure of performance
Application area: Professional Development; Digital Libraries

9. Comparisons of the types of scaffolding instructors employ in procedural and more complex training environments.
Independent variables: Demographics, 2 groups (complex vs. procedural training environments), prior experience with procedural and or complex training
Dependent variables: Post-test of performance, self-reported perceptions of professor,
Application area: BNCOC; OBC

10. The development of a procrastination questionnaire as a screening mechanism for students wanting to take an e-learning course.
Independent variables: Self-proclaimed procrastinators vs. non-procrastinators (score on 10-20 item survey of procrastination), previous experience with DL, other individual difference variables (self-efficacy, locus of control), number of DL courses taken in the past, demographics
Dependent variables: Desire for/likelihood of taking a DL course in the future, performance, degree to which you procrastinated in previous/current course –DL or trad.
Application area: Reserve Component; Reclassification training

11. What online environmental supports foster conversations and shared explorations that

form part of the user's active creation or co-creation of knowledge? (Harasim, 1990)
Independent variables: Multiple online forums (chat, question generation, team debate, email), demographics
Dependent variables: Report of collaboration, group work survey, measure of metacognitive activity, measure of performance
Application area: Battle Staff; Planning

12. What levels of control and autonomy are acquired by learners in the process of identifying, selecting, choosing, and using online information? (Bracewell, Breuleux, Laferriere, Benoit, & Abdous, 1998)?
Independent variables: Goal orientation, demographics, measure of dependence/independence, other individual difference variables, types of online information
Dependent variables: Self-report of control and autonomy in the four areas, course satisfaction
Application area: Reserve Component; Asynchronous training

13. How can technology better enable participants to find each other and form collaborative teams around mutual goals, skills, and work processes? (Roschelle & Pea, 1999)
Independent variables: Question generation/collaboration format vs. other technology-based collaboration formats, demographics, goals, preexisting skills, computer anxiety, self-efficacy
Dependent variables: Group work questionnaire, satisfaction, learning outcomes
Application area: Professional Development

14. How does participation in computer-mediated communication affect learners' motivation and sense of identity? (Warschauer, 1997).
Independent variables: Traditional vs. CMC, 2 different tasks, pretests: measure of motivation, goal orientation, self-efficacy, other demographics
Dependent variables: Post-tests: motivation measure, goal orientation, self-efficacy, desire for taking other CMC courses, satisfaction
Application area: Professional Development; Web-based training applications

15. Are there variations in the content and length of the dialogue for students receiving different levels of scaffolding in e-learning? (Bonk, Malikowski, Angeli, & East, 1998)
Independent variables: Groups receiving different levels of scaffolding (none, some, a lot), demographics, amount of dialogue experienced in the past
Dependent variables: Measure of dialogue: content, length, effectiveness, appropriateness
Application area: Web-based training; Synchronous training

16. How extensively do students use online practice tests and does this correlate with success after factoring out preexisting differences in metacognitive ability and/or motivation?

Independent variables: Learning styles, goal orientation, metacognition, motivation, computer anxiety, self-efficacy, other individual differences
Dependent variables: Use of online practice tests, performance measure/success
Application area: BNCOC; Reserve Component

17. Classify the cognitive (introduction to the problem, compare positions, draw conclusions, challenge solutions argue positions, etc.) and metacognitive acts (monitoring, evaluation, planning, etc.) of problem solving in small groups. Which skills are more prevalent and why?
Independent variables: Heterogeneous groups, demographics
Dependent variables: Group work survey, self-assessment of cognitive and metacognitive tasks used,
Application area: Battle Staff